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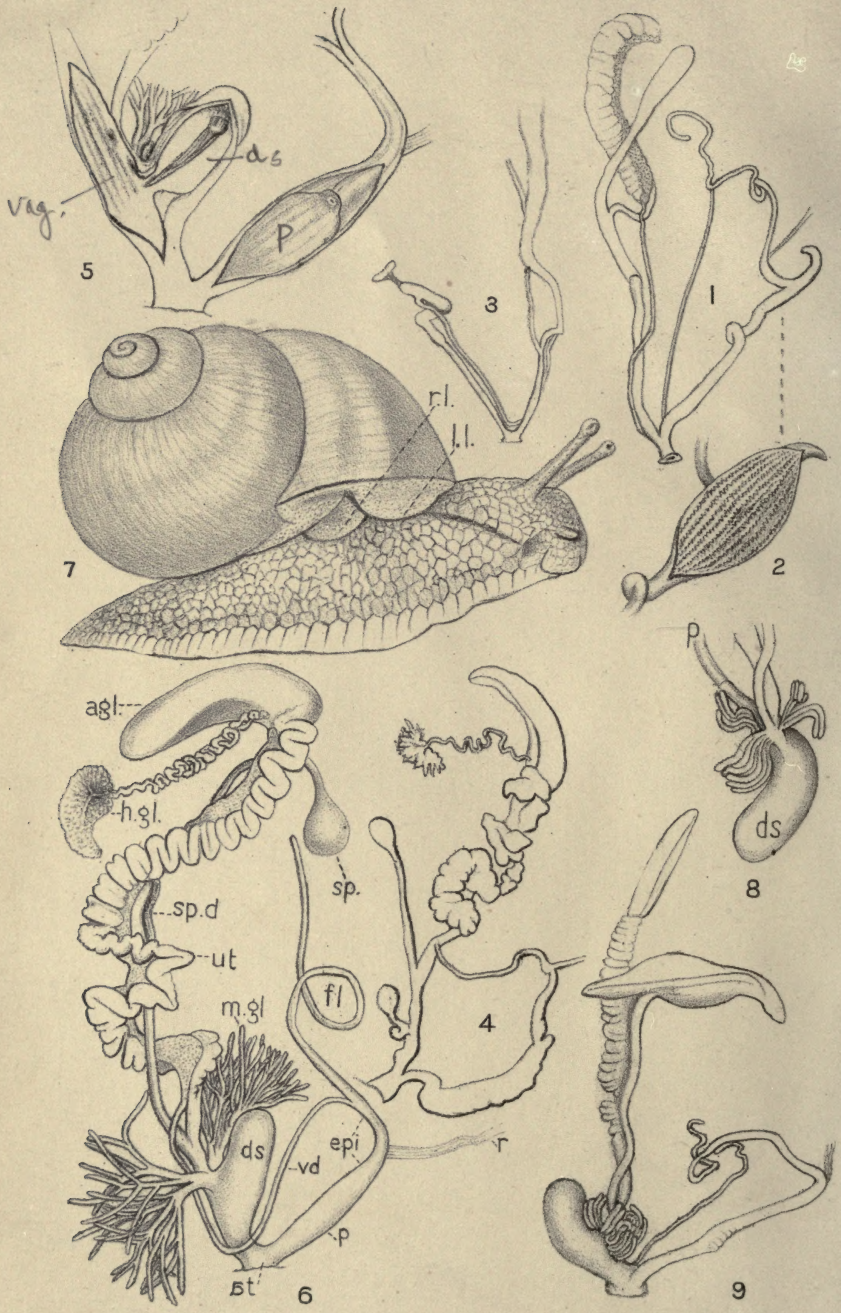

SECOND SERIES: PULMONATA.

MANUAL

OF

CONCHOLOGY;

STRUCTURAL AND SYSTEMATIC.

WITH ILLUSTRATIONS OF THE SPECIES.

BY GEORGE W. TRYON, JR.

CONTINUATION BY

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Vol. IX.

(HELICIDÆ, VOL. 7.)

GUIDE TO THE STUDY OF HELICES.

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PREFACE.

The group of Pulmonate genera familiarly known as Helices, forms an important factor in the land mollusk fauna of every country, in point of numbers exceeding any other group of snails. This numerical and faunal pre-ëminence has caused the authors of the MANUAL to devote eight volumes to Helicoid genera, the earlier three (Vol. II to IV) being prepared by Mr. Tryon, the later volumes by the writer.

During the progress of the work it became obvious that the established system of grouping required revision, not alone in the details of many minor divisions, but in those broader principles underlying our conceptions of the entire classification and genealogy of the group. The object of this volume is to formulate in compact form the new classification of Helices, and incidentally to indicate some general principles upon which a new grouping of all land pulmonates must be based.

In the systematic portion of the work (pp. 1-344) I have attempted to show the main characters of the genera, both in hard and soft anatomy, giving illustrations as copious as the limits of the work would permit; for while fully pursuaded that, as Darwin has said, naturalists "never read each other's works," I am sure that they look at the pictures illustrating them. In the Introduction the larger groups are defined (p. xxxii) and their probable genealogy suggested (p. xxxi). Finally, the geographic distribution of Helices is discussed with reference to the genesis and migrations of the principal groups, and the origin of modern faunas (p. xxxviii).

Few will dispute the general proposition that until the systematic classification of a group is placed upon a secure basis, all discussion of the larger questions of geographic and geologic distribution is futile. A sound systematic zoology is at once the key and the test of zoögeographic speculations; and without this check, zoologist and geologist are alike at the mercy of mere opinion and speculation, too often based upon false notions of affinity, or upon a decep-

tive external likeness which may mask fundamental differences. These considerations justify, I believe, the stress placed upon mere system in this volume. The treatment of minor groups may be objected to as unduly minute; and it is true that most groups seem over-divided. As my predecessors are responsible for most of this, I have been satisfied to reflect their labors faithfully. Those groups having important structural characters I have considered *generic;* grouping under these as subgenera and sections the various smaller assemblages, which specialists find useful, but which are usually of little systematic value, and not much utility to the general malacologist. These remarks imply no disrespect to the founders of this multitude of groups. Their labors were necessary in pointing out the differential features of Helices. They sought differences, for the establishment of new groups; the modern systematist seeks more profound likenesses, in order to establish lines of descent. The splitting of faunas into minute groups has taught us the comparative value of characters, paving the way for more philosophical study of the genealogy of faunas. The torch of analysis lights the path for synthesis.

It will, of course, be obvious that a general idea of the *contents* of the principal divisions of Helicidæ as here distinguished, must be obtained before the geographic hypotheses can be rightly understood.

Acknowledgements and Thanks. That a large number of Helicoid groups are made known anatomically in this work is primarily due to the kindness and generosity of many conchologists who have supplied living or alcoholic material for dissection; and while it would be impossible to name here all those who have thus assisted me with specimens, notes on distribution, synonymy, etc., I must express my obligations for material for investigation to W. G. Binney, John Brazier, Alfred Caruana Gatto, Dr. J. C. Cox, Wm. H. Dall, Henry Hemphill, J. B. Henderson, C. W. Johnson, O. von Möllendorff, Morris Schick, Dr. Benj. Sharp, Dr. H. Simroth, Frederick Stearns, Henry Suter and Rev. R. Boog Watson. A series of mounted radulæ which I owe to Rev. Prof. H. M. Gwatkin, has enabled me to illustrate the teeth of many interesting genera, among them Oxychona, Macrocyclis, Albersia, Planispira, Entodina, Acavus and others. My friend, Charles Hedley, of Sydney, has contributed not a little to views both systematic and theoretical expressed herein, but my main debt to him is for help more subtle than this.

To Mr. John Ponsonby, of London, thanks are due for numerous rare or new species of Helices, many of which have been figured in the Manual, and more especially for the correction of errors in synonymy, localities, etc., occurring in previous volumes of this work. Mr. G. K. Gude has rendered me a similar service; and from a very large number of conchologists both in America and abroad, I have received information upon particular species and genera, for all of which I would here express my gratitude.

Summary. In this volume the author has essayed to indicate the primary groups of the Helicidæ, arranging the genera according to a few main types of internal structure, in place of the chaotic or arbitrary sequence of groups hitherto prevailing. The multitude of groups recognized are shown to be reducible to about fifty genera distinguished by structural features of importance, which are described and illustrated, lists of the living species of each genus being given. An outline of the distribution of the main groups is offered, with hypotheses of the probable migrations and phylogeny of these groups. Incidentally, the comparative value of the genitalia, shell, jaw and radula in classification, and the laws of their modification are worked out in some detail. Finally, the nomenclature of Helices has been thoroughly revised, and, it is hoped, placed upon a sound basis.

It rests with the critical and discriminating conchological public to decide whether the author of this volume shall undertake a companion work on the genera of Zonitidæ and Agnatha.

H. A. P.

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MANUAL OF CONCHOLOGY, IX.

GUIDE TO THE STUDY OF HELICES.

INTRODUCTION.

I. Notes on the General Morphology of Helices.

Shell.

In Helices the shell is always a well developed spiral, capable of containing the entire animal when retracted. It is generally wider than high, and coiled loosely so that the central column is hollow or umbilicate, but in some forms it is much higher than wide, and the umbilicus is closed in the adult by an expansion of the lip, or the whorls are coiled in close contact, forming a solid columella.

The general contour of the shell is excessively variable in all genera containing many species; and as the number of main types of form is limited, parallel groups or species occur in the various genera as shown in the following table:

Genera.	Shell globose,	Shell depressed,	Shell keeled.
Helix	*Pomatia,*	*vermiculata,*	*gualtierana.*
Helicigona	*Arianta,*	*" Campylæa,"*	*lapicida.*
Epiphragmophora	*californiensis,*	*mormonum,*	*circumcarinata.*
Eulota	*Acusta,*	*Euhadra,*	*Plectotropis.*
Helicostyla	*Calocochlea,*	*Corasia,*	*Axina.*
Polygyra	*" Mesodon,"*	*tridentata,*	*obstricta.*
Thersites	*Xanthomelon,*	*Badistes,*	*Glyptorhagada.*
Camæna	*Phœnicobius,*	*xanthoderma,*	*saturnia.*
Obba	*papilla,*	*planulata,*	*marginata.*
Pleurodonte	*nuxdenticulata,*	*Isomeria,*	*Caracolus.*

The list is capable of indefinite extension; and even those minor groups called "sections" often show the same series of changes in form, thus:

Sections.	Shell globose,	Shell depressed,	Shell lens-shaped.
"*Dentellaria*"	*nuxdenticulata,*	*dentiens,*	*lychnuchus.*
Thelidomus	*emarginata,*	*petitiana,*	*lima.*
Pleurodonte	*bronni,*	*anomala,*	*peracutissima.*
Stenotrema	*stenotrema,*	*monodon,*	*spinosa.*
Axina	*montfortiana,*	*magister,*	*siquijorensis,*

That characters of contour are valueless for distinguishing genera in Helices is now conceded by students of the living groups, but palæontologists still use them; and for this reason the above tables are given.

The sculpture of Helices, like the contour, affords valuable specific characters, being subject to a wide range of mutation. Shells may be either smooth, obliquely striate, ribbed, decussated, granulated, malleated or hairy; and frequently several varieties of sculpture characterize different species of one genus, thus:

Genus.	granulate,	spirally striate,
Helicigona	*lapicida,*	*arbustorum,*
Polygyra	*palliata,*	*albolabris,*
Epiphragmophora	*tudiculata,*	*intercisa,*
Pleurodonte	*lima,*	*petitiana,*

ribbed,	hairy,	smooth.
gobanzi,	*setosa,*	*cingulata.*
obstricta,	*hirsuta,*	*jejuna.*
circumcarinata,	*rémondi,*	*mormonum.*
scabrosa,	*auridens,*	*marginella.*

Sometimes upon a smooth or granulate surface there are papillæ or hairs arranged in regular obliquely decussating series, or in quincunx. This occurs in some species of *Chloritis, Helicigona, Thysanophora, Lysinoe, Hygromia,* etc. Some genera exhibit a wide range of variation in texture and color, but in most cases this is correllated with the habits of the species. Tree living snails are, as a rule, bright colored and tend to become elevated or conical, while ground snails are duller or brown, and usually depressed. Some genera, like *Helicostyla* in the Philippines and *Cepolis* in the West Indies, contain both arboreal and terrestrial forms, and consequently appear, on superficial observation, to be composed of very incongruous elements.

The *embryonic shell* (the portion formed within the egg), is found to vary greatly in size, and its extent compared to that of the adult

shell is a character of considerable value in classification. In *Helicophanta, Acavus* and their allies it is very large, sometimes one-third the diameter of the adult shell, and its junction with the post-embryonic growth is distinctly marked. In *Polygyra* it is very small and indistinct. In *Camœna* and allied groups it is of medium size. Some genera have the embryonic shell sculptured, as *Anoglypta, Chloritis,* certain species of *Helicigona* and *Pleurodonte,* but it is usually smooth and polished.

The aperture is usually crescentic, half-round or round, but in keeled species becomes angular, and in those having teeth it is often ear-shaped. The outer lip is expanded, reflexed or thickened within in nearly all the genera, but in some (*Sagda, Glyptostoma,* etc.) it is simple and sharp as in *Zonitidæ.* Tooth-like processes are frequently developed upon the lip and parietal wall, and sometimes these become excessively complex. Usually there are two teeth upon the lip and one upon the body wall; totally diverse genera having independently evolved this arrangement. In a few groups there are internal plates or septa, far within the mouth.

The banding of Helices, althongh variable as a specific character, often shows considerable constancy in a genus or subgenus. Thus, in *Helix* the five-banded plan of coloring is usual. In *Helicigona* one- or three-banded; *Epiphragmophora* is one-banded. The band just above the periphery is the most constant, and may be found in most genera of Belogona. The Epiphallogona have their own band-arrangement, noticed on p. 103. Snails inhabiting dry situations or arid regions, deposit more lime in the shell than those living in moister places, and there is a strong tendency to split the bands into many narrow lines, as in *Euparypha, Helicella, Rhagada, Micrarionta.*

A convenient formula was invented by Georg von Martens many years ago, for the designation of band variations in Helices, especially the five-banded forms. The bands are numbered 1, 2, 3, 4, 5, beginning above. The absence of any band is indicated by a cypher; the coalescence of bands by parenthesis; and the splitting of a band by repetition of its number. Thus, the specimen shown in fig. 5, of plate 44, is *Helix nemoralis,* 12345. Fig. 4 is *H. nemoralis* 00000. Fig. 12 is *H. desertorum* 123(45). Pl. 43, fig. 44, is *H. saulcyi* 1(23) 40. A specimen with the bands united to conceal all the ground color would be (12345); and one with the third band split would stand 123345.

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External Features of Animal.

The general form of the animal in *Helicidæ* is similar to that of *Zonitidæ*, etc. The shell is carried on the middle or somewhat behind the middle, its axis being held oblique or vertical to the plane of the sole. The head has the usual eye-peduncles and tentacles, and more or less distinct labial lobes (see frontispiece, fig. 7). The mantle rarely projects beyond the lip-edge of the shell, and is generally provided with right and left body lobes (frontispiece, fig. 7, *r.l.* right lobe, *l.l.* left lobe). Sometimes the latter emits one or two small tongue-like processes on the left side (pl. 33, fig. 7). The back, from mantle to head, generally shows one or several *dorsal grooves*. The sides are granulated in various patterns, and often a groove extends from the lips obliquely upward to mantle on each side, the *facial grooves* (see pl. 33, figs. 7, 8; frontispiece, fig. 7). The tail in some genera has a median longitudinal groove (especially in *Epiphallogona*) or sometimes a serrate keel (*Lysinoe*, *Oxychona*). Usually, however, it is rounded above and shows no special features, being granulated like the sides, but more finely. In the *Endodontidæ* and *Zonitidæ* a deep longitndinal furrow runs parallel to the foot-edge on each side a short distance above it. These are the *parapodial* or *pedal grooves* (see pl. 14, fig. 46). They are absent in *Helicidæ*. In *Zonitidæ* and *Endodontidæ* these furrows are often associated with a mucus-secreting pore at the tail. The sole or creeping disc is divided longitudinally into three bands or areas in some genera, but in most Helices such division is absent, or indicated by coloring only.

Digestive Tract.

The jaw is well developed and usually strong and orange-colored in Helices. The types of jaw occurring in *Helicidæ*, *Endodontidæ*, and *Zonitidæ* are

Polyplacognath (or unsoldered type of jaw, see pl. 1, figs. 4, 5, 6, 9) consisting of numerous *separate* plates, overlapping at their edges, and united by a common membrane only (*Punctum*).

Stegognath (or plaited, pl. 15, fig. 6, 7) composed of similar or narrower vertical plates soldered together, but with free, overlapping outer edges (*Flammulina*, *Sagda*).

Goniognath (or converging-plaited, pl. 42, fig. 36) same as stegognathous type, but outer imbricating edges of each plate converg-

ing toward the middle below, the median plate or plates triangular, not reaching the cutting margin (*Plectopylis*).

Aulacognath (or striated, pl. 15, figs. 1, 2) primary elements or plates completely soldered together, vertically striated (*Pyramidula*).

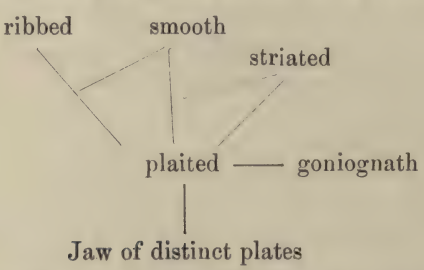
Oxygnath (or smooth, pl. 21, fig. 8) completely soldered, smooth (*Leucochroa*).

Odontognath (or ribbed, pl. 21, fig. 11) completely soldered, having convex vertical ribs, projecting at one or both edges (*Helix*).

The most primitive type of jaw occurring in recent terrestrial Pulmonata is found in the Polyplacognatha, *Punctum* and *Laoma*. By the partial union of the loose plates of this sort of jaw, the Stegognathous type is formed. The goniognath form as seen in *Liguus, Orthalicus*, etc., is a mere variant of this low stegognath type, and can hardly be considered a primary type. In the *Aulacognatha* the plates have become completely soldered, although their edges still show as striæ; and finally in the *Oxygnatha* these striæ disappear, leaving a completely smooth jaw. In the *Odontognatha*, vertical ribs are developed upon its anterior face. The data supplied by anatomy and embryology indicate the above as the general phylogenetic sequence of the various types of jaw; but the *Oxygnatha* consist of two sections of different genesis. In some forms (such as the typical Sagdas) the jaw has apparently been evolved directly from the stegognathous type; and this is probably true likewise of the *Helicophanta* group. In others (such as some species of *Pleurodonte*, and *Helicostyla*, the genera *Obba, Cepolis, Leucochroa, Allognathus*, etc.) a smooth jaw has resulted from the degeneration of the ribs on an odontognathous type. The ribbed or odontognathous type has in some cases been formed upon a plaited jaw. In other cases it may have been formed upon a smooth jaw, but evidence is lacking to establish this. In certain cases (such as *Hygromia*) the degeneration of a ribbed jaw has resulted in one approaching the plaited type. It must also be understood that the distinction between the goniognathous, stegognathous, aulacognathous and oxygnathous types is in some cases not well defined, and often it is not possible to distinguish between a *primarily* or *secondarily* oxygnathous or smooth jaw, although it is practically demonstrated that the Oxygnatha are diphyletic.

It therefore appears that at the time the main phyla of monotremate, jaw bearing land snails diverged, they were provided partly with a jaw of unsoldered plates, partly with one of the incompletely

united type (stegognathous or plaited). In the Helicoids the majority of forms acquired the firmer and completely united smooth or ribbed type, although some still retain the primitive, incompletely united forms, as seen in *Punctum*, *Flammulina*, *Thysanophora*, etc. In the *Zonitidæ* the oxygnathous type has been very generally acquired, although a few forms retain a modified plaited jaw. In *Bulimulidæ* (which includes the "Orthalicidæ") the plaited type of jaw has been retained with various modifications, and the same is found in *Cylindrellidæ*. The *Pupidæ* have a completely united, striated jaw. The *Achatinidæ* have a striated or ribbed jaw. It appears that the various families, starting with an incompletely united jaw, have been very unlike in the degree of development attained; some preserving the ancestral form until to-day, but in most a stronger, solid jaw has been acquired through various well understood successive stages, occasionally parallel in several phyla. These considerations show that the various classifications of land mollusks by jaw characters are artificial; the various "types" of jaw on which it is founded representing merely successive stages of progress from an incoherent or incompletely united, to a solid jaw, and these stages have been independently reached or passed through by several totally diverse branches of the pulmonate trunk. The history of the various jaw types is shown in the following diagram.



The two lower stages were probably passed through by the majority of families in common; the others were reached by various groups independently and by their own special routes. In most families of land snails, two or more of these types are represented among the various genera.

The Radula in *Helicidæ* is of the strap-like form usual in *Pulmonata*, the individual teeth having squarish basal plates. In even the lowest types now existing, the multicuspid form of tooth of the primitive Pulmonates has given way to the tricuspid type (see pl.

15, figs. 3, 4), although in some forms more cusps remain on the outermost teeth. The individuality of these three cusps is remarkably fixed; for however completely the typical tricuspid form may be changed, it is always possible to identify the three primitive elements, or such of them as are retained.

In the study of Helicid radulæ, and especially those departing widely from the typical structure, it is essential to recognize at the outset—

The law of mesometamorphosis: *All modifications in the teeth proceed from the median line of the radula outwards toward the edges, the outer marginal teeth being the last to be modified.*

A study of the marginal teeth, therefore, gives a clue in many cases to the ancestral condition of a much modified radula; although in certain groups the change has been so long established and has proceeded so far that even the outermost teeth no longer retain their primitive form. In such cases recourse must be had to the radulæ of young individuals or embryos still unhatched, which sometimes retain an ancestral type of teeth (see Sterki, Proc. Acad. Nat. Sci., Phila., 1893, p. 388).

The evident reason why the order of tooth-changes stated above should obtain, is that the median portion of the radula is the part most used on account of its position and the convex boss-like shape of the subradular cushion.

The most frequent departure from the tricuspid type of tooth is seen in the lateral teeth of most Helices, in which the inner cusp (entocone) is lost, or more commonly its cusp is united with that of the middle cusp (mesocone) as a lateral extension of the latter. In many groups both inner and outer cusps of rhachidian and lateral teeth are suppressed in this manner (see pl. 34, fig. 9), but all three cusps reappear on the marginal teeth, which are less modified. Usually the outer marginals have the ectocone, or outer cusp, split or bifid, a reminiscence of the early multicuspid teeth which were part of the heritage of the Pulmonates from their Tectibranch ancestors.

Radulæ with teeth tricuspid in whole or part. In many *Endodontidæ* and minute forms of other groups, the teeth are all tricuspid (see plates 8, 9). This form of teeth is usually correllated with small size and strictly terrestrial habits.

Radulæ with all teeth unicuspid. In a few genera the loss of side cusps has extended to even the outermost teeth of the radula (see

pl. 51, figs. 1, 2, and pl. 48, all figs.). This modification is especially characteristic of one of the primary divisions of Helices, but occurs also on a few isolated genera, such as *Allognathus*, of other phyla.

Radulæ of arboreal snails. Data presented in the systematic portion of this volume establish the fact that *arboreal snails always assume teeth with broad, gouge-like cusps*, in place of the slender, pointed cusps of ground snails, and regardless of the form of teeth prevailing in the family stocks whence they were derived. Cases in point are *Polymita*, *Amphidromus*, *Orthalicus*, *Papuina*, *Cochlostyla*, *Oxychona*, etc., etc. Some apparent exceptions are due to the very recent assumption of arboreal habits by certain forms; the change of teeth lagging behind the change of station, as in the arboreal forms of the genus *Cepolis*.

This modification goes hand in hand with the change in *shell* features; arboreal forms always becoming light or bright colored, often having a color-scheme in vivid hues of green, yellow, orange or pink; while the most nearly allied terrestrial species or genera have the shell of dusky or inconspicuous shades of brown.

In some tree snails the middle cusp only is modified into a broad gouge, the side cusps remaining as rudimentary basal spurs, which become larger on the outer edges of the radula, in accordance with the general law formulated above. An instance is *Oxychona*, pl. 51, figs. 9, 10, (*o* being the rhachidian tooth). Again, the *three* cusps are retained and enlarged on all the teeth, as in *Polymita*, pl. 51, figs. 5, 6, 7. (Fig. 7, outermost marginals; compare pl. 57, fig. 48, a marginal of *Cepolis*, the genus most nearly allied). The same has occurred in *Papuina*, pl. 37, figs. 1, 10.

As a general rule, groups of greater value than genera cannot be based upon these special modifications of the tricuspid type of teeth. And on account of the fact that similar modes of life produce similar tooth-forms in widely different groups, these peculiarities can have comparatively little weight in fixing the place in the general system or the family affinities of any genus.

The salivary glands, stomach, liver and intestine have not been observed to offer differences of taxonomic value in the Helices, although I have observed variations in certain genera. An extended series of observations of these organs is necessary.

Reproductive System.

General considerations:—Helicidæ, like all pulmonates, are hermaphrodites, the male and female genitalia uniting below in a com-

mon cloaca, the *atrium* or *vestibule*. It is now held that the hermaphrodite condition is secondary in mollusks, the male organs being superimposed or grafted upon the female individual (see Pelseneer Quart. Journ. Mic. Sci. 1894, p. 19). The proofs for this view coming from many sides, all indicate that in the primitive mollusks the sexes were separate.

Embryological data indicate that the entire generative system except atrium, penis sack and their special appendages, are of mesodermal origin. Simroth is probably right in holding that the atrium and evertible penis (but not epiphallus) are ectodermal evaginations. The case of *Limax primitivus* which he cites to prove that the penis has been "pulled out" from the atrium, is, however a case of degeneration in all probability. It is very probable that the penis in land mollusks is strictly homologous with that of Tectibranchs, and its union with the female organs at the atrium has been brought about by the gradual moving forward of the female orifice, originally posterior in position.

It seems likely that the dart apparatus is primarily an outgrowth from the atrium, although in some cases it has moved upward on the vagina. It is not homologous with the dart sack of *Philomycus*, nor with that of certain *Zonitidæ*. The gland or sack upon the penis, called the *appendix*, is probably a very ancient character, and is homologous with that sometimes developed upon the atrium (see *Helicella*), but not with the blind sack found high on the vagina in such forms as *Panda*, etc., which seems to be an independent growth from the vagina, probably serving as a temporary receptacle for spermatophores (packets of spermatozoa), analogous to the diverticulum of the spermatheca duct. Although both male elements (spermatozoa) and female (ova) are produced in the same acini of the hermaphrodite gland, the former ripen first, and passing down are enclosed in a leathery or chitinous case, the spermatophore ("*capreolus*") secreted by flagellum or epiphallus. In forms lacking these the spermatophore is absent. In the female system these spermatophores are stored in the spermatheca and its appendages, pending the ripening of eggs and their passage downward. The dart apparatus is only a stimulating organ, the dart being thrust from one individual into another during copulation. Von Ihering considers the papilla in the penis also a sensory organ. The function of the penis-gland is unknown. During copulation the penis is everted in most Helices, but in some there are reasons for

believing that the atrium only is thrust outward. Further investigations of snails during breeding are needed.

Description of organs:—The external opening of the genitalia lies a short distance behind and below the right (or in sinistral species the left) eye-peduncle. This opens into a short chamber the *atrium* (Frontispiece, *atr.*), from which the penis (*p.*) branches toward the digestive tract, and the vagina (*vag.*) toward the outer side. The *penis* (*p.*) is a tube with muscular walls, usually corrugated within, and sometimes having longitudinal fleshy pillars (*pilasters*, pl. 21 fig. 14, 15) adherent along one side to the wall of the cavity. At its distal end the *vas deferens* (*v. d.*) enters, its opening being sometimes at the base or summit of a papilla (the *penis papilla*, pl. 28, fig. 2). The *penis retractor* muscle (*r.*) is inserted on the penis or its appendages, and attached distally to the floor of the lung. The *vagina* (*vag.*) branches above into the *spermatheca duct* (*sp. d.*) which terminates in the *spermatheca* (*sp.*); the other branch (*uterus*, *ut.*) becoming enlarged and sacculated. At the apex of the uterus the *albumen gland* (*a. gl.*) supplying the albumen of the eggs, is attached; from near its base the *ovisperm duct* springs, and terminates in the *hermaphrodite gland* (*h. gl.*).

Besides the above essential organs, the genitalia of many snails are complicated by the presence of various accessory organs. On the male side the penis may bear a gland or sack of unknown function, called the *appendix* (see pl. 21 fig. 1, 2, 3). This structure may be near its apex, at its base, or even on the atrium. In some groups the vas deferens does not enter the penis directly, but becomes modified into a larger tube the *epiphallus* (*epi.*) which is continued beyond the apex of penis and frequently bears a long blind duct, the *flagellum* (*fl.*).

The female side in some groups is provided with a muscular sac upon the vagina (or atrium), the *dart sack* (*d. s.*), containing a needle or dagger-like calcareous *dart* (see frontispiece, fig. 5, section of dart sack, showing dart). Associated with this apparatus are found one or several glands, various in form, the *mucus glands* (*m. gl.*). In certain forms there is a curved hollow appendage high upon the vagina, which probably serves as a receptacle for spermatophores, and has been called the *appendicula* (see pl. 17, fig. 1). The duct of the spermatheca in some Helices bears a long blind tube, the *diverticulum* (see pl. 63, fig. 8).

The musculature of the genitalia is often a character of some value. The penis retractor may be inserted either on the penis itself, or on the epiphallus; and in a few cases it is split, having a double or triple insertion. Distally it is attached normally to the lung floor, but in a few cases to the vagina, or to the main columellar retractor of foot and buccal mass. In a few groups the penis retractor is absent. The vagina in some cases is attached to the adjacent body wall by a broad band-like muscle. The dart sack has no retractor, but in certain genera its apex is connected with the vagina. The retractor of the right eye-peduncle in most genera passes between the penis and vagina; but in a few it passes to the left of the penis. These myologic features are of considerable importance in classification; and the variation in the distal insertion of the penis retractor in some forms, as well as the abnormal position of the eye-retractor in others, are difficult to explain.

II. Historical sketch of the Classification of Helices.

Five epochs may conveniently be recognized in the taxonomic history of land mollusks. I, Linnæan epoch; II, Lamarckian epoch; III, Ferussacian, IV, Beckian, V, Albers-Martensian; each of these being initiated by the appearance of some work largely remodelling the system of classification.

I, 1758–1799. The Linnæan Epoch was characterized by the wide limits and heterogenous contents of its genera, although in a broad sense most of them have proved to be natural groups. Linnæus himself and his successors in Germany, France and England until the time of Lamarck, are the exponents of this period.

II, 1799–1819. Lamarckian Epoch. The genus *Helix* of Linnæus was much restricted about the beginning of the present century by the segregation of its most diverse elements by Lamarck and Draparnaud; the Limnophila, Clausilia, Pupa, Succinea, Achatina, etc. being removed to form distinct genera. Within the group of forms retained in *Helix*, but few divisions were made, and such genera as were instituted during this epoch were mainly based on one or a few peculiar species, no attempt being made to classify the entire series. Fischer de Waldheim (about 1808), Montfort (1810), Schumacher (1817) are the principal contributors to this literature.

III, 1819–1837. Ferussacian Epoch. The Tableaux Systematique de la Famille des Limaçons presented the first consistent attempt

to classify the Helices into subgeneric groups. After dividing the shell-bearing terrestrial inoperculate pulmonates into six genera, *Helixarion*, *Helicolimax*, *Helix*, *Polyphemus*, *Vertigo* and *Partula*, Ferussac proposes the following system for *Helix:*

† Redundantes.

Volutatæ, *Helicoides*, subgenus *Helicophanta* [=Daudebardia, Aerope, Helicophanta].
Evolutæ, *Cochloides*, subgenus *Cochlohydra* [=Succinea].

†† Inclusæ.

Volutatæ, *Helicoides*, subgenus *Helicogena* [=all globose Helices].
subgenus *Helicodonta* [=all toothed Helices].
subgenus *Helicigona* [=all keeled toothless Helices].
subgenus *Helicella* [=depressed, mostly simple lipped Helices and *Zonitidæ*].
subgenus *Helicostyla* [=elevated Helices, not keeled].
Evolutæ, *Cochloides*, subgenus *Cochlostyla* [=Bulimoid forms, imperforate, with entire mouth].
subgenus *Cochlitoma* [=Liguus, Achatina].
subgenus *Cochlicopa* [=Glandina, Stenogyra, Ferussacia].
subgenus *Cochlicella*, [=Cochlicella, Rumina, etc.].
subgenus *Cochlogena* [=Limicolaria, Bulimus, Achatinella, etc.].
subgenus *Cochlodonta* [=Pupa, Strophia, Gibbus, etc.].
subgenus *Cochlodina* [=Cylindrella, Clausilia, Buliminus].

Each of these subgenera is divided into several groups designated by terms expressive of their peculiarities, thus:

S.-g. *Helicella* { Lomastomæ, Aplostomæ, Hygromanes, Heliomanes, } S.-g. *Helicostyla* { Aplostomæ. Lamellatæ. Canaliculatæ. Marginatæ. }

These divisions of the subgenera were not intended in the sense of sub-subgenera and should not be used in such sense. Many of them

were repeated in several subgenera, and it is only by accident that any of them are acceptable in form. Such names as *Hyalina* (Hyalinæ Fér.), *Heliomanes*, etc., cannot date from the *Tableaux*. The subgeneric divisions of Férussac's system are based almost wholly upon *contour*, one of the least stable characters of Helices. The system is, therefore, wholly artificial. Other writers of this epoch are Risso (1826), who by restricting the heterogeneous subgenera of Férussac, fixed their types; Leach, whose subgeneric names are quoted in the synonymy of Turton's work (1831); Fitzinger (1833), who proposed generic names for many European groups; and Charpentier (1837) who publishes certain names proposed by Agassiz. The latter three authors did not work on Férussacian lines, but may rather be regarded as foreshadowing the next epoch.

IV, 1837–1860. Beckian Epoch. A great advance in Helicology marked the year 1837. The period of artificial classification waned; and with the works of Held and of Beck a new period dawned. Held's work applied only to the European Helices; but Beck included all known species in his classification. Discarding the arbitrary contour-grouping, Beck formed his subgenera upon the elusive and less striking, but far more stable features of shell structure and texture, form of lip and columella, etc. A large proportion of the groups proposed in the *Index Molluscorum* are still retained in essentially their original limits. Although founded upon shell characters only, Beck's classification is a vast advance upon previous work; and indicates a mind of rare subtlety and discrimination. During the decade following Beck's publication, several notable works upon Helices appeared. Swainson (1840) attempted to apply the "quinary system," proposing at the same time some new genera. Hartmann (1840–1844) also made additions to the list of names and Pfeiffer, whose name was to be henceforth so intimately associated with all departments of Pulmonate species-work, published the Symbolæ ad Historiam Heliceorum (1841–'42), and in 1848 the first volume of the famous *Monographia Heliceorum*. Pfeiffer's main strength was in the discrimination and concise, explicit, description of species, and in the careful sifting of synonymy; and in these lines his work has been of incalculable benefit to science. As a systematist his views were not especially original.

J. E. Gray issued in 1847, a list of genera with their types; and this publication fixes definitely the type species of a number of old genera of Helices, such as *Obba*, *Cochlostyla*, etc.

The publication of Albers' *Die Heliceen*, in 1850, marked a distinct advance in the discrimination of natural groups throughout the land snails; but the general principles followed do not differ radically from those of Beck. In 1855 Pfeiffer published a somewhat amplified arrangement, with some new subgeneric names; and in the same year the brothers Adams reached the Helices in their Genera of Recent Mollusca. The classification adopted in this work differs widely from previous arrangements; but as its original features are nearly all either retrogressive or founded upon fallacious characters, the generic and subgeneric scheme need not be quoted here. Reeve's monograph of *Helix* in the Conchologia Iconica (1851–1854) supplied the first illustrations of a multitude of species, chiefly those of Pfeiffer. Dr. Binney's Terrestrial Mollusks of the United States (1851–1857) gave a magnificent series of plates of American forms, among the best portraits of snails ever published; and the work of Dr. Joseph Leidy therein, was the first anatomical investigation to be made on American Mollusks.

In France, Moquin-Tandon was preparing a faunal work of the same thorough character, which was issued in 1855, with sumptuous colored plates and well-drawn anatomical details of the snails of France.

Simultaneous with the last, Adolph Schmidt published his Geschlechtsapparat der Stylommatophoren in taxonomischer Hinsicht (Berlin, 1855), a classic work, ranking with that of Semper in the grasp of principles, and laying a broad foundation for the comparative study of snail genitalia. Schmidt establishes upon anatomical data the groups *Pentatœnia* (=*Helix* s. str.), *Fruticicola*, *Xerophila*, *Campylœa*, shows the true relationships of the *carthusiana* and *nummus* groups and of *H. pisana* and *personata*, separates *H. obvoluta* from the *personata* group, etc. Many of these notable improvements in classification have since been completely lost sight of by recent European conchologists, and are only of late fully appreciated.

The work of Schmidt belongs to the Beckian period only chronologically. In insight and genius it is altogether modern.

V, 1860– . Albers-Martensian Epoch. While several works of the decade preceding 1860 were far in advance of the standpoint of Beck, yet their scope was not sufficiently wide to create any general change in the views of Helix classification held in various countries. The appearance of the second edition of Albers' Die

Heliceen, edited by von Martens, marked a period closed, and a new epoch begun.

As the classification given in this work has been the basis of nearly all subsequent systematic arrangements, it is here quoted in full The brackets indicate that groups so united are supposed to be closely allied. For purposes of comparison I have given in Roman type the names of the super-generic groups of this volume, under which each of the Albers Martensian subgenera falls, these groups being as follows:

Endodontidæ: Haplogona, Polyplacognatha.

Helicidæ: Protogona, Teleophallogona, Epiphallogona, Belogona (with two divisions, Bel. Euadenia and Bel. Siphonadenia), Macroögona.

Vitrinea.

Genus SAGDA Beck (Teleophallogona).

Hyalosagda, Proserpinula, Odontosagda.

Genus LEUCOCHROA Beck (Belogona).

Helicacea.

Genus HELIX L.

Amphidoxa, Haplogona.
Microphysa, Teleophallogona.
Aerope, Rhytididæ.
Pella, Haplog. & Zonitidæ, etc.
Patula, Haplogona.
Charopa, Haplogona.
Stephanoda, Haplogona.
Rhytida, Rhytididæ.
Janulus, Zonitidæ.
Endodonta, Haplogona.
Sesara, Zonitidæ.
Pelia, Zonitidæ.
Gonostoma, Belog. siphonadenia.
Ophiogyra, Protogona?
Polygyra, Protogona.
Stenotrema, Protogona.
Triodopsis, Protog. & Belog.
Mesodon, Protogona.
Laoma, Polyplacognatha.

Acanthinula, Belogona.
Vallonia, Belogona.
Petasia, Belogona.
Fruticicola, Belogona.
Dorcasia, Protogona & Belogona.
Rhagada, Epiphallogona.
Xerophila, Belog. Siphonadenia.
Turricula, Belog. Siph.
Cochlicella, Belog. Siph.
Ochthephila, Belogona.
Actinella, Belogona.
Tectula, Belogona.
Plectotropis, Belog. Euadenia.
Aegista, Belog. Euad.
Aglaia, Belog. Euad.
Campylæa, Belog. Siph.
Eurycampta Belog. Euad.
Arionta, Belog. Siph. & Euad.
Eurystoma, Epiphallogona.

Euparypha, Belog. Siph.
Tachea, Belog. Siph.
Macularia Belog. Siph.
Iberus, Belog. Siph.
Coryda, Belog. Euadenia.
Hemicycla, Belog. Siph.
Plebecula, Belog. Siph.?
Leptaxis, Belog. Siph.
Pomatia, Belog. Siph.
Thelidomus, Epiphallogona.
Cysticopsis, Belog. & Teleoph.
Plagioptycha, Belog. Euad.
Polymita, Belog. Euad.
Liochila, Epiphallog. & Belog.
Eurycratera, Epiphallogona.
Polydontes, Epiphallog.
Helicophanta, Macroögona.
Panda, Macroögona.
Stylodon, Macroögona, Belog.
Erepta, Zonitidæ.
Dentellaria, Epiphallogona.
Cepolis, Belog. Euad.
Pleurodonta, Epiphallogona.
Anostoma, Pupidæ.
Labyrinthus, Epiphallog.
Isomeria, Epiphallogona.
Caracolus, Epiphallogona.
Phania, Macroögona?
Thersites, Epiphallogona.
Merope, Epiphallogona.
Obba, Epiphallogona.
Trachia, Epiphallogona.
Planispira, Epiphallogona.
Phasis, Haplogona?
Chloritis, Epiphallogona.
Pedinogyra Macroögona.
Ampelita, Macroögona.
Solaropsis, ?
Camena Epiphallog., & Belog.
Hadra, Epiphallog., & Belog.
Papuina, Epiphallog.
Leptoloma, Belog. Euadenia.
Geotrochus Epiphallog. & Belog.
Cymotropis, Epiphallogona.
Chloræa, Belog. Euadenia.
Corasia, Belog. Euadenia.
Axina, Belog. Euadenia.
Callicochlias, Belog. Euadenia.

Genus COCHLOSTYLA Fér. Belogona Euadenia.

The general plan of this arrangement is to establish a series leading from Zonitoid to Bulimoid shells; and the characters mainly depended upon in the formation of groups are texture, form of lip, and general contour of shell. In the appreciation of that indefinable something, which counts for so much in classifying Helices, the authors of Die Heliceen are far beyond all previous work; and it is this quality—this accurate *feeling* for subtle affinities for which no good reason can be given in words—that has rendered this work the basis of classification for three and a half decades, a long period in so changeable a science as malacology.

It would be obviously unfair to criticise this great work by standards of the new anatomical classification, for excepting the *Haplogona*, *Protogona* and *Belogona*, the Helices were practically unknown anatomically in 1860. Compared with the new system, it is noteworthy that the *Haplogona* are mostly grouped together near the Zonitidæ, where they unquestionably belong; and many other felicities of grouping will be obvious to one looking over the list, besides the genius shown in forming natural subgenera, already referred to. For the rest, the *Epiphallogona*, *Belogona*, *Teleophallogona*, *Proto-*

gona and *Macroögona* are indiscriminately grouped; but with the exception of the last named, which has good conchological peculiarities, one would expect this; for there are no diagnostic characters of these super-generic groups to be found in the shells alone.

The work of Pfeiffer, although begun in the last period, extended through the greater portion of this one. Final results of this great series of monographs are given in the Nomenclator Heliceorum Viventium, edited by Clessin (1878). The system of classification differs but little from that of Albers-Martens.

The successive papers and volumes of Binney and Bland upon the land shells of America, although based on Die Heliceen, have made notable improvements in the treatment of cis-Atlantic groups, largely the result of Binney's work upon the jaws and radulæ of United States and West Indian species. The work of Tryon upon Helices has been based upon conchological studies only, and is essentially a modified form of the Albers-Martensian. Fischer likewise gave no weight to anatomical characters in his treatment of Helices.

The systematic work of Mörch, although begun in 1859 (Mal. Bl. vi, 109), belongs to this epoch rather than the last. Fully recognizing the unreliability of groupings based upon shell-contour, he proposes to use the jaw as a basis for dividing land snails into primary groups. The arrangement given is as follows, the genera of Helicidæ being italicised:

1. Oxygnatha. Jaw with a projecting tooth, Limax, Vitrina, Succinea, *Helicella*, Zonites, *Leucochroa*, Ryssota, *Obba*, *Caracolla*, *Otala*, *Pleurodonta*.

2. Aulacognatha. Jaw striated, with crenulated margin. *Euryomphala*, *Bradybæna*, *Sagda*, *Cochlicella*, Rumina, Pupa, Clausilia.

3. Odontognatha. Jaw with separated cords which form teeth at its margin, Arion, Ariolimax, Nanina, *Teba*, *Pomatia*, *Helicogena*, *Helicogona* (Campylæa), Achatina, Limicolaria, Bulimus.

4. Goniognatha. Orthalicus, Pseudostrombus (=Liguus).

5. Agnatha. Oleacina, Testacella.

In 1855 (Journ. de Conchyl.) this idea is further elaborated and the *Elasmognatha* added. As I have shown on a previous page (xi), the jaw is as unreliable as the shell; and the family groups

based upon it are almost always artificial. Still, the attempt to use internal features was in itself a move in the right direction.

The above classification paved the way for the great work of Dr. Carl Semper, Reisen im Archipel der Philippinen, Landmollusken. In this, the most extensive work yet published upon the soft anatomy of land mollusks, a great number of genera in all families of snails are made known anatomically, the following scheme of classification being adopted.

Family Zonitidæ: tail with gland; marg. teeth aculeate, etc.

Family Helicidæ: no caudal mucus-gland.

Vitrininæ: Sole divided, margined; jaw smooth; marginal teeth thorn-like. Limax, Vitrina, Parmacella, Vitrinoconus, Vitrinoidea, Hyalina.

Helicinæ: Sole undivided; jaw various; marginal teeth short, several-cusped.

Oxygnatha:

Teeth unicuspid: Acavus, Corilla, Caryodes, Panda, Caracolus, Labyrinthus.

Teeth broad, several-cusped.

Tentacles 2. Janella.

Tentacles 4; jaw with accessory plate: Succinea.

Tentacles 4; jaw with no accessory plate: Oopelta, Trochomorpha, Planispira, Obbina, Strophia, Sagda.

Aulacognatha: Philomycus, Cionella, Tornatellina, Stenogyra, Endodonta, Buliminus, Pupa.

Odontognatha:

No accessory organs on genitalia: Achatina, Amphidromus, Bulimus, Otostomus, Partula, Hadra, Pleurodonta, Polygyra, Trachia.

Genitalia with accessory organs: Cochlostyla, Chloræa, Eulota, Xerophila, and other genera [this group of Semper's is the foundation of v. Ihering's "Helicidæ" and Pilsbry's "Belogona"].

Goniognatha: Orthalicus.

Agnatha: Rhytida, etc., etc.

Family Onchididæ.

Family Vaginulidæ.

Although founded upon the arrangement of Mörch, this classification exhibits a distinct advance, not only in the recognition of the

subordinate value of the jaw structure (which Semper considered of much less moment them would be thought from the above table), but in the partial recognition of the value of features of the genitalia, teeth, mantle, foot-grooves, etc., here for the first time made much use of in classification. The great number of genera investigated anatomically, and the admirable way in which the work was done, have made Semper's work a classic in malacological literature. The principal defects of the classification are the exaggerated importance given to the mucus tail gland, and the structure of the jaw. Moreover, shell characters were practically ignored—an extreme view, not borne out by broader investigations.

During the Albers-Martensian epoch, much good detail work upon the anatomy of Helices has been done by investigators using Die Heliceen and Semper's Reisen as their main reference books. Among these may be mentioned the work of W. G. Binney, Wiegmann, Pfeffer, Schuberth, Brancsik, Lehmann, Fischer, Tapparone-Canefri, Hutton, Hedley, Suter, Hesse, Pollonera, Braun, Morse and others referred to in the text of this volume. Moreover, the advance in knowledge of the shell has been unparalleled, many acute and talented conchologists giving their energies to the elucidation of the Helix faunas of every quarter of the world, and bringing to scientific knowledge a vast number of interesting species, as well as adding enormously to the data for zoögeography.

During the years 1889–1892 the writer published anatomical data upon various Helices bearing upon a new classification of the entire group, these memoranda being practically the basis of the present volume.

The Morphologie und Systematik des Genitalapparates von Helix, by Dr. H. von Ihering, appearing in 1892, has exercised a wide influence upon views of Helix classification, and placed the main European genera upon a firm basis. In this powerful essay, v. Ihering adopts the second division of Sempers' *Odontognatha* as a group of family rank, the *Helicidæ*, with the following genera: *Xerophila*, *Fruticicola*, *Helix* [=Pentatænia Schm.], *Campylæa*, *Gonostoma*, *Dorcasia* [=Eulota], *Cochlostyla*. He also treats of *Neohelix* (new name for *Polygyra* Say), but does not attempt to show its affinities; and the exotic Helices of which the relationships were unknown to him are placed under the new genus *Parahelix*. The great merit of this work lies in its advanced views regarding the value of the various modifications of the genitalia in

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systematic malacology, the role played by degeneration, and in formally adopting and suitably characterizing the main European genera as originally outlined by Schmidt. In the preliminary classification proposed by the writer (Proc. Acad. Nat. Sci. Phila. 1892, p. 392) these European groups were placed as subgenera of *Helix*, but a fuller study of the subject has resulted in the adoption of the genera defined by von Ihering.

III. New Classification of Helices.

It will be seen by reference to the preceding pages that the classification of Helices has been based hitherto mainly upon the modifications of a single organ, such as the shell or the jaw; and that even the best of these classifications have yet given no clue to the relations the various groups of different life-areas bear toward one another, nor have they even remotely suggested any phylogenetic lines. In the present volume the attempt has been made to found a system of grouping based upon several organs, and one expressive of the facts of phylogeny and zoögeography.

Single-organ classifications are even more than usually dangerous in Pulmonates for we find that they have, like their ancestors the Tectibranchs, an extremely plastic shell which shows many cases of parallel or "converging" development, and frequently becomes reduced to a functionless remnant, in members of widely different families, and their mouth parts are subject to great changes in nearly allied groups. The Prosobranchs show no such wide range of mutability in either shell or radula.

It is generally held by biologists that a classification which takes cognizence of several totally diverse, uncorrellated organs, is more reliable than one based upon a single organ; for the reason that while some one organ or system of directly correllated organs, may independently assume similar forms in members of different stocks or phyla, when they are subjected to similar conditions of life, the probabilities are remote that several organs not directly correllated will be simultaneously so modified. Again, the ancestral form of a certain organ may be retained in several groups widely diverse in other respects; and moreover, the taxonomic value of a given structure varies widely in different families or genera.

Another consideration of weight in selecting characters for a phylogenetic classification, is the fact that peripheral organs, or those *directly* acted upon by external forces, are most readily remoulded

or modified by these influences, while internal organs are much less directly acted upon, and lag behind in the process of transformation. For this reason, specific characters as well as those of sections or subgenera are mainly drawn from the shell, while generic features are usually found in the dentition, jaw and genitalia. As a rule, these internal organs in any genus, show a far smaller range of variation than the shells. In this connection it may be noted that the appendages or organs of the foot (such as operculum, mucus glands, pedal grooves, etc.) show much less variation in any natural genus or family than the mantle organs (shell, mantle lobes, etc.).

The generally acknowledged facts recited above, with the conclusions reached regarding the taxonomic value of the shell (page vii), the jaw (p. xi) and the teeth of the radula (p. xiii), have as their logical outcome, caused us to form a classification of the land snails based upon all the main features of the animal economy, special dependence being placed now upon one, now upon another system of organs. Former arrangements of the genera based upon one or two organs, must sooner or later be abandoned. Neither jaw, teeth or shell, taken singly, prove to be sufficiently stable, nor is v. Ihering's primary division of Pulmonata into *Micronoten* (small-mantled, such as *Helix*, *Limax*, *Pupa*), and *Meganoten* (large-mantled, as *Vaginulus*, *Philomycus*), any more natural.

In the opinion of the writer, a natural classification of Pulmonates should be based upon :—

Organs of protection (shell, mantle, integument of body).
Organs of locomotion (foot with pedal-grooves, tail gland, etc.).
Organs of reproduction (genitalia, comparative size of eggs, etc.).
Organs of nutrition (jaw and teeth, intestinal tract, kidney).
Nervous system (including sense-organs such as tentacles, etc.).
Muscle system.

In applying this scheme to the Helices, I have not attempted to use characters of the nervous system, partly because neither the requisite time or space is at my command, partly because other organs promised results of more immediate utility. The other organic systems named I have tried to study impartially. Although the foundation of this system throughout rests upon comparative anatomy, I have been influenced in some cases, where anatomical data are wanting or insufficient, by the facts of geographical distribution ; but this class of facts I have purposely held subordinate to anatom-

ical affinities, even when as in the case of *Pleurodonte* (p. 86), I could not at the time of writing, see the slightest connection between the clearly expressed organic characters, and the apparently anomalous distribution.

Classification of Snails with Jaw and a Helicoid or Zonitoid Shell.

Key to families.

[It will readily be understood that for purposes of a key, only the most obvious peculiarities are chosen; too much space would be required were the diagnostic characters of all organs to be given].

I. Foot-edges with no trace of pedal grooves; no tail gland; sole undivided. Side teeth unicuspid, thorn-shaped, with narrow basal-plates. Shell with simple lip and without opaque markings, SELENITIDÆ.

II. Foot margin defined by a pedal groove. Shell sharp-lipped.

a. Marginal teeth with narrow, elongated basal-plates, and either unicuspid and thorn-shaped by suppression of side cusps, or bicuspid by elevation of outer on middle cusp. Tail gland often present, and sole frequently tripartite, ZONITIDÆ.

b. Marginal teeth with wide, short and squarish basal-plates, with one or several cusps, the outer cusp never elevated on middle cusp. Shell with opaque, brown coloring or flammules, usually rib-striate, the lip thin, unexpanded and sharp, ENDODONTIDÆ.

III. Foot-edges without pedal grooves; no tail gland. Marginal teeth with wide, short, squarish basal-plates and one or several cusps, the outer cusp never elevated on middle cusp. Shell usually with expanded or reflexed lip, HELICIDÆ.

This series of families is allied on one side to groups which have undergone degeneration of the jaw, such on *Rhytididæ*, and on the other to the families to be monographed in succeeding volumes of the Manual. The *Selenitidæ* and *Zonitidæ* will not further be considered in this volume, with the exception of a single genus of the latter (Trochomorpha, page 1), which Tryon and Fischer erroneously intercalated among the Patuloid snails.

Synopsis of genera of Endodontidæ.

- Endodontidæ
  - Polyplacognatha
    - *Punctum*, p. 6.
    - *Laoma*, p. 8.
  - Haplogona
    - *Flammulina*, p. 10.
    - *Phasis*, p. 36.
    - *Amphidoxa*, p. 39.
    - *Endodonta*, p. 20.
    - *Pyramidula*, p. 42.
    - *Pararhytida*, p. 52.

Synopsis of genera of Helicidæ.

- Protogona
  - Jaw ribbed N. American
    - Penis retractor trifid, *Praticolella*, p. 67.
    - P. retr. simple
      - lip well reflexed, *Polygyra*, p. 68.
      - lip unexpanded, *Polygyrella*, p. 78.
  - Anat. unknown, S. Amer. Papua.
    - whorls rounded, S. American, *Polygyratia*, p. 81.
    - whorls keeled, Papuan, *Coxia*, p. 83.
  - Shell many-whorled.
  - Jaw smooth, S. African, *Dorcasia*, p. 172.
- Macrogona
  - No blind sack on vagina
    - Eggs or young very large
      - Keeled, emb. whorls decussate, columella short, with convex lobe or tooth, *Stylodonta*, p. 149.
      - Not keeled, columella concave, lip narrow, *Helicophanta*, p. 151.
      - Not keeled, lip very wide, colored, *Acavus*, p. 153.
    - Eggs of moderate size
      - Keeled; lip and columella wide, colored, *Pyrochilus*, p. 154.
      - Columella narrow, lip not bright, *Ampelita*, p. 155.
  - A blind sack on vag. or sp. duct.
    - Shell Helicoid
      - Quoit-shaped, yellow, finely striate, *Macrocyclis*, p. 165.
      - Quoit-shaped, dark and solid, *Pedinogyra*, p. 158.
      - Subtrochiform, rough above, smooth below, *Anoglypta*, p. 159.
    - Shell Bulimoid
      - Apex spirally lirate, suture crenulate, *Caryodes*, p. 161.
      - Apex beaded or smoothish, suture even, *Panda*, p 163.
- Teleophallogona
  - *Thysanophora*, p. 54.
  - *Sagda*, p. 58.
  - *Zaphysema*, p. 65.

aaa. No mucus gland at tail.

b. Holarctic forms *Pyramidula*, p. 42.

bb. E. Indian, Australian and Oceanic forms *Endodonta*, p. 20.

3. Jaw solid and smooth; penis with flagellum (?) and appendix; shell moderately large, solid and strong. *Pararhytida* p. 52.

The genera of this group rest upon much slighter characters than those of *Helicidæ*. *Flammulina*, *Phasis* and *Amphidoxa* are separated mainly upon their geographic distribution, and many prove to constitute but one genus. *Endodonta* and *Pyramidula* are retained distinct for the same reason. The genitalia of very few of the southern hemisphere forms are known, and the jaws and teeth are not especially characteristic.

Key to genera of Helicidæ.

The author has purposely abstained from assigning subfamily rank to the natural tribes of Helices defined below. If they be considered subfamilies, they may bear the names 1 Polygyrinæ; 2 Acavinæ; 3 Sagdinæ; 4 Camæninæ; 5 Helicinæ.

I. Genitalia simple; vas deferens inserted directly on the well-developed, long penis, which has no epiphallus or flagellum; no dart sack or mucus glands; no diverticulum on spermatheca duct; eggs small and numerous. Jaw solid, ribbed or smooth; marginal teeth with more than one cusp. Shell with lip thickened within, expanded or reflexed, the embryonic whorls not distinctly differentiated PROTOGONA.

II. Genitalia simple, the vas deferens inserted directly on penis or enlarged into an epiphallus; no flagellum. No dart sack or mucus glands, but sometimes having a blind sack or appendicula high on vagina; eggs or young at birth very large, hard-shelled. Jaw solid, smooth or vertically striate; teeth all unicuspid; embryonic shell large, generally distinctly differentiated from later growth by diverse sculpture or a terminal wrinkle. Shell large and solid MACROOGONA.

III. Genital system having an epiphallus and flagellum developed on penis, and a complicated, flagellum-like appendix, or penis gland; female side without dart sack or other accessory appendages; eggs calcareous-shelled, or young born alive. Jaw smooth or plaited; rhachidian teeth tricuspid, laterals bicuspid.

Tail with a longitudinal groove above. Shell somewhat Zonitoid, unicolored, with sharp simple lip, neither thickened or reflexed TELEOPHALLOGONA;

IV. Genital system having an epiphallus and flagellum on penis (but these structures obsolete in some Pleurodontes and Planispiras); appendix or penis gland small if present; female side with no accessory appendages. Eggs small or moderate in size. Jaw smooth or ribbed; radula with two or more cusps on part of the side teeth. Shell usually solid, the lip expanded or reflexed EPIPHALLOGONA.

V. Genital system having epiphallus and flagellum (rarely wanting) on penis; a dart sack and mucus glands (rarely wanting) on vagina, and frequently a diverticulum on the long spermatheca duct. Eggs of small size. Jaw ribbed, smooth or plaited; teeth with several cusps on marginals (except in *Allognathus*). Shell solid or thin, often conspicuously banded BELOGONA.

Some few exceptions to the above scheme are due to degenerative groups of the higher tribes, which simulate lower tribes, and are only to be correctly placed by attention to the totality of their characters. Of this sort are *Cristigibba*, which by degeneration of penis and its appendages is like the *Haplogona;* and *Ciliella, Metafruticicola* and *Cochlicella*, unquestionably *Belogona*, by the loss of their dart apparatus resemble *Epiphallogona*.

Tribe I, PROTOGONA.

a. Jaw ribbed. North American forms.

b. Penis retractor with trifid insertion; a large accessory sack on penis; shell globose, unkeeled, white with translucent or brown bands, lip narrowly reflexed *Praticolella*, p. 67.

bb. Penis retractor not split; no large sack on penis; shell yellowish or brown.

c. Lip well reflexed, often toothed, but no internal teeth; striate above; spermatheca duct short *Polygyra*, p. 68.

cc. Lip not in the least reflexed, but thickened within; texture glassy; spermatheca duct long *Polygyrella*, p. 78.

aa. Jaw and soft anatomy unknown; shell discoidal, with many narrow whorls.

b. Whorls rounded at periphery; South American *Polygyratia*, p. 81.

bb. Whorls carinated at periphery; Papuan region *Coxia*, p. 83.

aaa. Jaw solid, smooth; penis sack continued slightly beyond insertion of vas deferens; duct of spermatheca long; shell globular or depressed-globose; S. African, *Dorcasia*, p. 172.

Tribe II, MACROOGONA.

a. No blind sack or appendicula on vagina or spermatheca duct. Eggs or young at birth very large, about one-third the diameter of adult shell; shell with more less reflexed lip, the embryonic whorls distinctly demarked from after growth.

b. Shell keeled, at least when young, imperforate, finely wrinkled, the embryonic 3½ whorls spirally grooved or decussate; columella short, vertical, its inner edge with a convex lobe or acute fold. Viviparous, Seychelles Is. *Stylodonta*, p. 149.

bb. Shell capacious, not keeled; embryonic whorls over one-third diameter of adult, post-embryonic growth 1½ whorls or less. Aperture large, lip narrow, dilated at columellar insertion; columella concave, toothless. Madagascar *Helicophanta*, p. 151.

bbb. Shell imperforate, globose-depressed or trochoidal, not carinated, solid, bright colored; embryonic shell about ⅛ diameter of adult. Lip broadly reflexed, vividly colored *Acavus*, p. 153.

aa. No blind sack on vagina or spermatheca duct; junction of nuclear shell with after growth not distinct; lip expanded or reflexed.

b. Shell acutely keeled, at least when young; lip usually bright colored, the columella widened into a flat plate. Moluccas *Pyrochilus*, p. 154.

bb. Shell umbilicate (except in Pœcilostylus), the lip not bright colored, not widened at columella. Madagascar *Ampelita*, p. 155.

aaa. Vagina or spermatheca duct bearing a blind sack. Lip of shell narrow or simple. Eggs and embryonic shell smaller.

b. Shell Helicoid, umbilicate, wider than high.

c. Shell solid, dark colored, quoit-shaped with wide umbilicus, flattened spire and subhorizontal, oblong mouth, the lip blunt, subexpanded, rounded; vagina with appendicula; jaw smooth. Australian, *Pedinogyra*, p. 158.

cc. Shell subtrochiform, conoidal and tuberculate-lirate above, polished and one-banded below the peripheral keel; outer lip with a deflexed angle; spermatheca duct with a sack; jaw striate. Tasmanian *Anoglypta*, p. 159.

bb. Shell bulimoid, higher than wide; outer lip neither expanded or reflexed.

c. Upper whorls spirally lirate, with crenulated suture. Tasmanian *Caryodes*, p. 161.

cc. Upper whorls finely beaded or smoothish, suture even. Australian *Panda*, p. 163.

aaaa. Soft anatomy unknown; teeth all unicuspid; shell quoit-shaped, with wide umbilicus and low spire, uniform yellowish, densely striate; lip narrowly expanded throughout. S. America *Macrocyclis*, p. 165.

Tribe III, Teleophallogona.

a. Shell smooth, depressed or trochoidal, light yellowish, having the texture of *Hyalina*, composed of 6–9 narrow, closely coiled whorls. Aperture small, narrowly lunate, often with internal laminæ, the lip thin, sharp and simple *Sagda*, p. 58.

aa. Shell globose, imperforate, of 5-6 convex whorls, the last large, inflated, brown; aperture large, rounded-lunate, toothless, the lip thin and sharp, closely appressed at the white-calloused columella *Zaphysema*, p. 65.

aaa. Shell conic or depressed, thin, not opaque, pale brownish or corneous, umbilicate; surface rather dull, often bristly or with delicate riblets; whorls 4–6½, separated by deep sutures. Aperture round-lunate or oblong, toothless; lip thin, often a trifle expanded *Thysanophora*, p. 54.

Tribe IV, Epiphallogona.

a. Epiphallus developed, flagellum usually present, but short.

b. Penis retractor inserted at apex of penis; American *Pleurodonte*, p. 84.

bb. Penis retractor inserted on epiphallus; Old World.
c. Penis with a feather-shaped appendix; jaw smooth *Obba*, p. 107.
cc. No such appendix.
d. Apex or whole shell with points in quincunx; jaw ribbed *Chloritis*, p. 117.
dd. Genitalia unknown; jaw ribbed; shell imperforate, with columella wide above *Albersia*, p. 124.
ddd. Not so sculptured.
e. Solid, capacious, rough sculptured; embryonic shell rather large *Camœna*, p. 101.
ee. Rather solid, depressed, depressed-globose or keeled *Thersites*, p. 125; *Planispira*, p. 110.
eee. Trochoidal, thinner and mostly light colored *Papuina*, p. 136; *Ganesella*, p. 168.
aa. Epiphallus or flagellum more or less obsolete.
b. Epiphallus more or less obsolete, flagellum present *Polydontes*, etc., p. 87.
bb. Epiphallus and flagellum obsolete *Cristigibba*, p. 112.

Tribe V, Belogona.

a. Mucus glands sacculated, club-shaped, bulbous or flattened, glandular, inserted on dart sack or at its base, never on vagina above dart sack (except in *Lysinoe*, p. 191, in which there are 3 club-shaped glands on vag.) *Belogona Euadenia*, p. 175.
aa. Mucus glands tubular or finger-like (except in *Elona*, p. 307), and always inserted on vagina, never on dart sack or accessory sacks *Belogona Siphonadenia*, p. 235.

Key to Genera by Shell Characters.

A key to groups of Helices based upon shell features only, cannot be made without numerous double entries, and even then to be exhaustive it would be extremely complicated, probably too complex to be of use to beginners in the science, for whom alone it

would be intended. The following table simply shows the genera arranged according to some of the more obvious shell characters.

I. Shell with lip thin and sharp, as in *Zonites*, not expanded, reflexed or with a rib-like thickening within.

1, American: *a*, no internal teeth or laminæ: Pyramidula 42, Punctum 6, Amphidoxa 39, Hyalosagda 61, Thysanophora 54, Zaphysema 65, Glyptostoma 192, Polymita 184.

b, with internal teeth or laminæ: Helicodiscus 51, Sagda 58.

2, Old World: *a*, no internal laminæ or teeth: Pyramidula, Punctum 6, Phrixgnathus 9, Flammulina 10, Phasis 36, Charopa 22, Pararhytida 52, Anoglypta 159, Caryodes 161, Panda 163, Pupisoma 52, Acanthinula, Chalepotaxis 167.

b, with internal laminæ or teeth: Atlantica 50, Laoma 8, Endodonta 20.

II. Shell with lip blunt, hardly or not at all expanded, usually thickened within.

1, American: Polygyrella 78, Polymita 184.

2, Old World: Pedinogyra 158, Leucochroa 232, Helicella 245, Geomitra 238, Hygromia 269, Acanthinula 280.

III. Shell with lip expanded, not flatly reflexed.

1, American: Praticolella 67, Polygyratia 81, Macrocyclis 165, Thysanophora 54, Pleurodonte 84, Cepolis 177, Lysinoe 191, Epiphragmophora 193, Oxychona 189, Vallonia 282, Solaropsis 166.

2, Old World: Coxia 83, Dorcasia 172, Stylodonta 149, Helicophanta 151, Ampelita 155, Camæna 101, Obba 107, Chloritis 117, Albersia 124, Thersites 125, Planispira 110, Papuina 136, Ganesella 168, and most genera of *Belogona*.

IV. Shell with the lip decidedly reflexed, often toothed.

1, American: Polygyra 68, Vallonia 282, Pleurodonte 84, Lysinoe 191.

2, Old World: Acavus 153, Pyrochilus 154, Camæna 101, Obba 107, Chloritis 117, Thersites 125, Planispira 110, Papuina 136, Helicostyla 216, Chlorœa

214, Eulota 200, Vallonia 282, Helicodonta 284, Helicigona 296, Helix 311, Plectopylis 143, Corilla 147.

IV. Distribution of Helices in Time and Space.

The bare facts of distribution of the several genera and species are sufficiently stated in the systematic portion of this work; it remains to draw the more obvious conclusions which they indicate. As to *means of distribution*, there is much reason to believe that upon continental areas, land snails, like mammals, have been mainly dependant upon their own powers of locomotion, although rivers with their flood-carried debris have doubtless been effective. Such island faunas as are not traceable to former land connections, are probably due to drift wood and "floating islands" swept from rivers; for although in rare cases the agency of birds or cyclones may have been efficient, still the evidence of such means of transport of land snails is extremely slight, and the facts now known do not warrant or call for any extensive invocation of means so extraordinary and exceptional, and so completely hypothetical. It will readily be understood that the case with freshwater snails is quite a different subject.

The key to the wide distribution of many genera or super-generic groups of terrestrials, is the known fact of their vast antiquity, which has enabled them to take advantage of the various land combinations of several geological periods, and also of the rarely occurring means of transport mentioned above.

The fact must constantly be borne in mind that the evolution of Pulmonates has been excessively slow; and although the terrestrial forms have changed more rapidly than the freshwater mollusks, they cannot be compared with mammals or birds in this respect. Many genera of Helices dominant to-day, are known to have existed in the early Miocene, and apparently as distinct then as now. In the Eocene, forms less close to the recent occur, but in many cases they cannot be generically different. In the mammalia we find the roots not only of families, but of *orders* in Eocene strata, while even the *genera* of Helices have scarcely changed since that time. The super-generic groups must, therefore, strike deep into Mesozoic time. As the means of transport of land snails are very limited and slow, they lag far behind such freely mobile creatures as mammals and birds; and, therefore, we do not find, nor can we expect to

find that the life areas defined by mollusks and those based on the vertebrates named, correspond in all respects; although the much greater time limit in the case of mollusks to some extent offsets their slower movements. The same factor of greater antiquity introduces another disturbing quantity into the equation; for land mollusks have been able to take advantage of early continental and insular connections which no longer existed when the modern orders of placental mammals came upon the stage.

In the following pages, the distribution of the Helices will be discussed in order of groups. It will readily be understood that the hypotheses offered, whether borrowed or original, are simply suggestions, subject to such changes as the study of other groups or of palæontology demands, or to complete rejection. They are based, however, on a careful consideration of the facts now known, with regard to land snails generally; and are, I trust, fair inferences from these facts.

Endodontidæ. As will be seen in the systematic part of this work, this family is intermediate between *Zonitidæ* and *Helicidæ* in its characters, and it is decidedly less specialized than either. While it may not be in the direct line of descent of these two families, it is certainly nearer than either of the others to the common ancestor of the three, as is shown by its unspecialized jaw, teeth, genitalia and shell. Palæontology has yet given but little to the history of the group, but that little is significant; the Carboniferous of Nova Scotia has afforded a small Helicoid described as *Zonites priscus* Cpr., which in form and ribbed-striate sculpture can only be compared to such *Endodontidæ* as *Pyramidula* or *Charopa.* In my opinion this species is to be regarded as the oldest form of Helicoid yet known, and as a probable member of the genus *Pyramidula.*

Agreeing with this view of the antiquity of the group is the fact that the *Endodontidæ* have a wider geographic range now than either *Helicidæ* or *Zonitidæ*, inhabiting the entire Holarctic realm, the southern extremities of S. America and Africa, Australo-Zealandic land, and almost all oceanic islands of the entire globe. Upon the continents they are very scarce or absent in the tropics, probably from the competition of numerous newer groups; and it is mainly in island faunas, where they do not compete with true *Helicidæ*, that snails of this family abound. The presence of very similar forms in southern South America and Tasmania and New Zealand, has been accounted for by the hypothesis of a former more

extensive Austral continent or "Antarctica," which may have been supplied with these snails as well as with certain marsupials, fishes, etc., from Australia, and subsequently became united at Cape Horn, transferring the fauna. The connection could hardly have been in a reverse order, or why should not Edentates and Hystricomorph Rodents have invaded Australia? The principal papers bearing on such continental connections in relation to mollusks are those of Hutton, von Ihering and Hedley. It is obvious that the *Endodontidæ* and *Helicidæ* alone are insufficient to base much speculation upon regarding former extensions of Austral land. A similar question occurs with regard to the fauna of South Africa, which in the presence of *Endodontidæ*, *Rhytididæ*, *Cœliaxis*, etc., shows affinity to that of New Caledonia, Australia and Tasmania. The flora, according to Hooker, also has affinities with the West Australian.

Helicidæ–Protogona. This group, as the name implies, is believed to be nearer the ancestral stock of the family than the other groups, mainly because of the simplicity of the genitalia, which are as in *Endodontidæ*, the less modified *Zonitidæ*, the *Rhytididæ*, etc. The palæontological history of the group is very scant, a few species entirely modern in aspect being found in Miocene strata of Florida. Some forms of equal or greater age are reported from the western United States, but none of them are really known to belong to this group. The references to *Triodopsis* and *Mesodon* by writers on the European Tertiary are groundless, the supposed *Triodopsis* belonging to *Isognomostoma*, the Mesodons to *Mesodontopsis*, a group near *Tacheocampylæa.*

Of the living forms, *Polygyra*, *Polygyrella* and *Praticolella* are exclusively North American, the first named having a few species in the West Indies, and a few which have penetrated from the head valleys of the Missouri to those of the Columbia, and thus reached the northwest coast, the others being East American. There cannot be much doubt that the ancestors of this group of genera have occupied East American soil ever since it had a fauna of *Helicidæ*, and with the Pyramidulas, to the exclusion of other groups of Helices. In South America the genus *Polygyratia* occurs; and while it is likely that its affinities and past history are similar to the preceding North American forms, no safe conclusions can be drawn until the anatomy is known. The species from New Guinea and New Ireland, grouped under *Coxia*, are also beyond the limit of profitable speculation.

The South African genus *Dorcasia*, although so widely separated geographically, seems to be a member of this group of genera. It is probably a remnant of a large number of Protogona which may have had a wide range in the Eastern Hemisphere in Mesozoic times.

Macroögona. This group comprises all the large Helices, in fact all the *Helicidæ* of Madagascar and the Seychelles, with genera in Ceylon and Moluccas, and another group of genera in eastern Australia and Tasmania (see page 148). No profitable speculations can now be based upon this peculiar range, which probably dates from Mesozoic time. The largest known Helices belong to this group, as well as some very handsome forms, such as *Acavus hæmastomus* and *Pyrochilus lampas*, described in the last century. As a temporary expedient, we have placed the N. Chilian group *Macrocyclis* here, but it may prove to belong elsewhere, possibly to Protogona, when the genitalia come to be examined.

Teleophallogona. As stated on p. 56, this group, consisting of three genera only, is essentially West Indian. *Zaphysema* is restricted to Jamaica; *Sagda* is nearly as local, although a few species from Hayti and Cuba are referred here; while *Thysanophora* is universally diffused throughout the West Indies, and occurs on the mainland from Trinidad to Florida.

Epiphallogona. The range of this group of genera includes Australia (but not Tasmania), the Solomon Islands (but neither New Caledonia or New Zealand), New Guinea north throughout the East Indies, and the mainland of Asia from India to Japan. In America it covers the West Indies and northern South America. The majority of genera and species are insular.

Arising from an Oriental Protogonous stock now extinct, probably a remnant of the same which had much earlier given birth to the *Macroögona*, this tribe seems to have radiated in all directions. There is no evidence showing that it ever extended further west than at present; but in the north it evidently passed over a Bering bridge, and travelled southward in America, becoming established in the West Indies, probably in Secondary times. In this invasion of American soil, the ancestors of the West Indian and Mexican genera of *Cyclostomatidæ* and *Cyclophoridæ* probably shared, the nearest allies of these groups being Oriental forms.

Whether the American Clausilias accompanied this early exodus, or a later one, remains uncertain; and the same is true of the

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Glandinidæ and *Streptaxidæ*, which, indeed, may have originated in America. On the south and south-east, the Oriental area of Epiphallogona overlaps somewhat that of the much older Austral fauna of *Endodontidæ, Rhytididæ* etc., which lies mainly south and east of the range of the other group. Similarly, the Epiphallogona extend southward far beyond the range of the Belogona. The succession of these faunas from south to north in this Asio-Australian belt of islands, is extremely significant, and clearly indicates the comparative ages of the groups in that region. *The chronological order of appearance* of Endodontidæ, Macroögona, Epiphallogona and Belogona, as determined by theoretical grounds from their comparative anatomy, *coincides with the evidence given by their geographic distribution.*

Belogona. By comparing the organs of such an Epiphallogonous form as *Chloritis* (pl. 28, figs. 1–4) with some Asiatic or American Belogona, such as *Monadenia*, pl. 59, figs. 81, 86, or *Mastigeulota*, pl. 66, fig. 26, it will be noticed at once that the structure of the male genitalia is identical in the two groups; each having a short penis continued in an epiphallus which bears the retractor and ends in a flagellum. The female side is alike in the two groups in having the spermatheca duct long and branchless, the other organs being identical except that in the Belogonous groups *the dart apparatus is added.* The jaw, teeth and shell show no features diagnostic of the groups Epiphallogona and Belogona. It is, therefore, highly probable that the latter group originated from the former, merely adding the dart apparatus to the characters already possessed by the parent stock. There is no especial reason for believing that this transformation took place in any other area than that now occupied by the most nearly allied modern forms of each of these groups, *viz.* southeastern Asia or the adjacent island groups. The evidence derived from comparative anatomy tends to show that the dart apparatus of the Helices was evolved *de novo* in this group, and while analogous to that of the *Zonitidæ*, it is not homologous. As in *Zonitidæ*, the glands associated with the dart sack were originally proliferations from that sack; and this structure is still retained in the Oriental and American genera constituting the Belogona Euadenia. In the European group of genera the glands have moved from the dart sack to the vagina, and are generally found inserted above, never below, the insertion of the dart sack. This is a purely secondary change, and together with the modification of

the glands into the tubular or finger-like form, is characteristic of the BELOGONA SIPHONADENIA.

The *Belogona Euadenia* in the Old World extend from Japan and India southward throughout the East Indies, with a few *Corasia*-like forms in New Guinea and the Solomons. That they are chronologically a later element than the *Epiphallogona* is shown by the fact that they are represented in the southern and southeastern portion of this range by only one genus (*Helicostyla*), and even this is much restricted, being absent in Australia, the Louisiades and New Hebrides, etc., where Epiphallogona are well represented. On the north, the mainland of Asia offered easy passage to Japan; and during a period of mild climate in high latitudes, and of elevation of the Bering Sea region, the *Euadenia* penetrated westward to America and south east to California, Mexico and South America, crossing to the West Indies by way perhaps of a Yucatan-Cuba ridge of elevation.

The date of this exodus of Asiatic life we are unable now to fix; but it could hardly have been later than the beginning of the Eocene, and there are good reasons for believing it earlier. At the same time, while it may have been coincident with the ingress of Epiphallogona into America, it was probably later; for no Belogona reached the Caribean chain (where a well differentiated group of the other tribe is universally represented), and its distribution eastward in South America is less great. In North America the barrier to eastward distribution has apparently been due to extensive inland seas in the Rocky Mountain tract, and upon their disappearance to arid climatic conditions. At all events, we now have in America several sharply defined generic types: *Cepolis*, the peculiarities of which have been evolved on Antillean soil, and which gave rise to a side line of arboreal snails, *Polymita*, the early origin of which is shown by its retention of three cusps on all teeth; a feature now lost in the other genus, some divisions of which have also assumed arboreal life, with its consequent remodelling of the radula. On the mainland the Mexican genus *Lysinoe* offers characters clearly telling of ancient divergence; and this is supported by the discovery of a species apparently allied to *L. ghiesbreghtii* in the Puerco Group of New Mexico, this Eocene horizon being below the Wasatch Group, immediately above the Laramie (*H. nacimientensis* White, Bull. U. S. Geol. Surv. no. 34, 1886, pl. 5, f. 3–7). Associated with this *Lysinoe* in the Puerco are *Holospira* and numerous fresh-water forms.

Several Eocene species from Utah and Wyoming are probably referable to *Epiphragmophora;* and perhaps the Miocene *Helix leidyi* Hall & Meek belongs here also; though the condition of preservation of these fossils of the fresh-water strata of the West, is quite insufficient for positive generic identification, which must await the finding of more perfect material.

Returning to the Palæarctic region, we observe that a few species of *Eulota* have penetrated into Central Asia, and one, *E. fruticum*, as far as eastern Europe. This form is evidently a late-comer, being absent from the loess fauna, and belonging to a section of *Eulota* characterized by the degeneration and loss of the flagellum. Its late advent in Europe may be correllated with the presence in China of a few European types such as *Helicodonta* and *Metodontia*.

The *Belogona Siphonadenia* are *par excellence* the Helices of Europe. Judging purely by the present distribution of the group, its diagnostic peculiarities seem to have been assumed in the European or adjacent tracts, whither the ancestral stock of *Belogona Euadenia* had emigrated from the Orient. Probable companions of these *Belogona* were the terrestrial operculates (some of which have been erroneously referred to West Indian genera), and perhaps the Agnatha, although the origin of these is problematic. In this European extension of the Palæarctic fauna the Siphonadenious phylum has split into numerous genera, and apparently has crowded out any earlier Helices of simpler structure, if such ever existed in that quarter of the world. The old families *Endodontidæ* and *Zonitidæ* retained their place owing probably to the notably different stations occupied by them. Very early branches of the European Belogona were *Leucochroa*, a probable remnant of the original stock which did not share the changes resulting in modern *Siphonadenia;* and *Vallonia*, a genus well differentiated in the early Eocene of Europe, now more widely dispersed than any other genus of *Helicidæ*, and possibly antedating the European immigration. Further notes upon the *Belogona Siphonadenia* will be found on pages 235–237. The only Siphonadenia which have strayed far from the area now occupied by the majority of the genera, are certain Chinese forms referred to *Helicodonta* and *Hygromia* (*q. v.*), which from their close resemblance to European types are probably recent colonies moving eastward through Siberia. Thus, *Metodontia* seems closely allied to *Dibothrion*, a group of middle Europe and Siberia; and *H. biconcava* of China is nearly allied to the European Miocene *H. involuta*

as the Chinese *H. binodata* is to certain living and tertiary European species.

* * *

Summary by Continents. The Americas are poor in autochthonous types of Helices (and land snails generally), the genera *Polygyratia*, *Solaropsis* and *Macrocyclis* being the only South American forms of great antiquity, the genera *Epiphragmophora*, *Pleurodonte* and probably *Oxychona* having been derived from the north in comparatively recent times, and the *Amphidoxa* forms are in all probability stragglers from the Australian tract.

The West Indies claim one group of genera, *Sagda*, *Thysanophora* and *Zaphysema* of evidently great age and unknown ultimate affinities, but the other elements, *Pleurodonte*, *Cepolis* and *Polymita* are Mesozoic or early Eocene immigrants from the mainland, and primarily from Asia.

North America possessess in *Polygyra*, *Polygyrella* and *Praticolella* a primitive fauna, to which has been added from Asia, the belogonous forms *Vallonia*, and the stock now differentiated into *Epiphragmophora*, *Lysinoe*, *Glyptostoma* and the West Indian genera mentioned; this addition can scarcely have been later than Cretaceous or base of the Eocene.

Africa is in the north practically a part of Europe; but at the Cape a Helix-fauna of as primitive a type as that of eastern North America is found, consisting of the genus *Phasis* of *Endodontidæ* and *Dorcasia*, a type allied to *Polygyra*, and probably a remnant of the early wider distribution of the *Protogona*. S. Africa has real affinities with Australia, but whether these are due to the preservation of antique types in both tracts, or to some actual connection, remains to be solved. Madagascar is much more allied to Ceylon and Australia than to S. Africa.

Europe and western Asia. The western portion of Asia together with Europe and North Africa, is peopled by a peculiar, highly organized type of Helices practically confined to these regions, but evidently derived ultimately from extreme south-east Asia or the East Indies, by a Cretaceous (?) migration.

Eastern Asia, from Japan and China southward to Australia, constitutes another great division in Helix distribution, and the middle of this area has been in all probability the birth-place of the groups *Epiphallogona*, *Belogona* and *Macroögona*. These three divisions still occupy the region, various genera of the first, *Camœna*, *Chloritis*,

Thersites, *Obba*, *Planispira*, *Papuina*, *Ganesella*, being characteristic of all portions of the tract. The *Belogona* have a smaller range southward, but in the genera *Helicostyla*, *Eulota* and their allies, extending over the central and northern portions of the region. The several genera of *Macroögona*, such as *Helicophanta* and *Ampelita* in Madagascar, *Acavus* in Ceylon, *Panda*, *Pedinogyra*, *Anoglypta*, etc. in Australia and Tasmania, have a much broken, discontinuous range, indicating a high antiquity and much extinction; but the origin of the group from Protogonous ancestors, within the general region now covered by the several genera, is probable.

In conclusion: We find that the distribution of Helices in space and time is not hap-hazard or erratic, as has been supposed from the earlier classifications, and from the erroneous generic and subgeneric references contained in works on the fossil forms, but that it is orderly and comprehensible. We find that, whenever the data are sufficient for judgment, the genera and species of any given life-area exhibit such affinities to each other and to those of adjacent areas, that no orographic changes or continental extensions other than those recognized by geologists as either demonstrated or probable, are necessary to account for the various snail faunas of to-day. We find that not only is it unnecessary to throw land bridges across the depths of Atlantic and Pacific to account for the distribution of Helices, but that such hypotheses are contrary to many facts indicating that such groups of snails as are common to America and Europe, have radiated from an Oriental center westward to Europe and eastward *via* the Bering Sea route to America, while in the far south a hypothetical extension of the Antarctic continent fulfils the conditions asked by the zoögeographer. Another fact worthy of remembrance is that in each faunal region, one or a few types of Helices have been modified to fill the several stations available, and that the most highly modified forms are generally found to be nearest akin to the normal Helices of the same region, not to similarly modified Helices of other regions. Thus, the groups *Phengus*, *Papuina*, *Oxychona* and *Leptoloma* are strikingly similar, yet they are not related to each other, but to less abnormal snails occupying their several areas. The same is true of *Caracolus* and *Thersites*; *Camæna*, *Euhadra* and *Hadra*, *Stylodonta* and *Columplica*, *Isognomostoma* and *Triodopsis*, and scores of other groups.

V. Preparation of Land Snails for Anatomical Study.

Land snails intended for anatomical examination should be placed when collected in a vessel of water from which air is excluded. Usually twenty-four hours is a sufficient time to drown the animal, when they may transferred to 50% alcohol and after a day to 60 and then 80%. It is often impossible on account of lack of facilities to observe this rule; and in such cases the animal may be thrown into about 60% alcohol when drowned. If time or facilities cannot be had for drowning the snails in water, they should be killed by the usual method, by scalding with boiling water, and then placed in spirit not stronger than 60%. *The one process to be avoided is plunging the living animal into spirit;* as this causes so much contraction that subsequent work is very difficult. Of course even a badly contracted specimen is vastly better than none; and no malacologist should neglect to preserve some sort of specimen of a species not known anatomically, in view of the present condition of malacology, and the advantage to be gained for science by the expenditure of the small amount of time involved in preserving the soft parts.

The dissection of land snails is very easy, a shallow vessel with a floor of blackened wax, some small scissors, a scalpel and pins being all the material required. After removing the shell and observing external features, an incision may be made extending from the top of the head backward, laying open the visceral mass. The genitalia will then be seen on the left (the head being toward the observer), the digestive tract in the middle. Each of these systems may be readily removed and pinned out separately for examination. Jaw and radula may be mounted in glycerine jelly in the usual manner.

Note on Nomenclature.

The numerous changes from previous usage in generic and subgeneric names of Helices, which have been introduced in this volume, are mainly due to a rigid adherence to the rule of priority. The older generic and subgeneric names were nearly all proposed for miscellaneous and artificial assemblages of species; and in these cases we are compelled to accept these names in the sense in which subsequent authors understood them and restricted them. For example: Férussac's *Helicigona* comprised *all* keeled and edentulous Helices; but as Risso retains under that name only the *H. lapicida* and *H. cornea,* we must accept this restriction; and as *cornea* was

not included by Férussac in his group, while *lapicida* was, we are obliged to consider the latter species the type of *Helicogona* Fér. Some authors demand that a generic name to be accepted, must be not only appropriate in meaning, but also be correctly limited by its describer; but such a course would only result in utter confusion. Thus, if correct limitation be insisted upon, we might have given new names to about half the genera as recognized herein, for fully that many are composed of materials never before brought into the present associations and groupings. Instead of such a course, we have invariably tried to select for each group, the oldest name applied to any of its members.

Regarding specific nomenclature, we believe that the dictum, "once a synonym, always a synonym," is the only satisfactory course. Thus, *Helix edwardsi* Cox was changed to *H. nigrilabris* because there was a prior *Helix edwardsi* of Bland; and this change holds, even though the shells of Cox and of Bland are now known to belong to different genera. On the other hand, *Polygyra hemphilli* W. G. B. is not held to be preoccupied by the earlier *Helix hemphilli* Newc., because Binney described his species as a *Triodopsis*, not a *Helix;* and as *hemphilli* W. G. B. is a Polygyra, and *hemphilli*, Newc. a Pyramidula, there has never been a duplication of the binomial term "*Helix hemphilli.*"

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Genus TROCHOMORPHA Albers, 1850.

Trochomorpha Albers, Die Heliceen, p. 116.—Martens, Die Hel. (edit. 2), p. 60, type *trochiformis* Fér.; Ostasiat. Zool., Landschn. p. 245.—*Discus* Albers, *l. c.*, p. 117.—Martens *l. c.*, p. 61-type *metcalfei* Pfr. Not *Discus* Fitz., *q. v.*—*Nigritella* Martens, Die Hel. (edit. 2), p. 63, type *nigritella* Pfr.; Ostas. Landschn., p. 246.—*Videna* H. & A. Adams, Gen. Rec. Moll. ii, p. 115.—Martens, Ostas. Landschn., p. 247.—*Sivella* Blanford, Ann. and Mag. Nat. Hist. (3) xi, p. 86 (1863), type *castra* Bens.—*Geotrochus* v. Hasselt, Algemeene Konst- en Letterbode voor het Jaar 1823, p. 233 (=*Trochomorpha* sp. and *Sitala* sp.)

Shell *varying from high trochiform to depressed lens-shaped*, umbilicate or at least perforate; solid and opaque, or thin and subtranslucent; carinated, at least in the young. Having 5–6 whorls. Surface rather smooth. Embryonal whorl not marked off from the after growth. Aperture basal, the upper lip terminating at the keel or periphery; *peristome simple* and sharp, or thickened and blunt, the basal margin arcuate; *columellar margin arcuate, short, not dilated or reflexed*; ends of lip distant. Type *T. trochiformis* Fér., pl. 7, figs. 8, 9. (See also pl. 7, figs. 1–3, *T. quadrasi* Hid.; pl. 7, figs. 4–6, *T. merzianoides* Grt.; pl. 7, fig. 7, *T. meleagris* Pfr.)

Animal: Foot long and rather narrow; sole flat, *with no trace of longitudinal division*; *parapodial groove distinct*, bounding a wide vertically grooved foot margin, and having a shallower groove above it. Tail depressed above, rounded behind, *without a mucus gland*. Back with several indistinct longitudinal rows of granules; sides irregularly granular. Shell lappets none; but mantle having a wide body-lappet on the right and a small one on the left. Lung orifice to the left of the superior angle of aperture. (pl. 8, fig. 12, *T. assimilis* Grt.; fig. 13, *T. beckiana* Pfr.; pl. 9, figs. 32, 33, *T. timorensis* Mts.).

Genitalia simple, the penis moderately long, somewhat twisted, the retractor muscle and vas deferens entering at the apex. Spermatheca on a short duct. (Pl. 8, fig. 9, *T. assimilis;* fig. 14, *T. beckiana*; fig. 17, *T. troilus;* fig. 19, *T. subtrochiformis;* figs. 15, 16, *T. metcalfei; pl. 7, figs.* 14, 15, *T. planorbis*). Orifice of genitalia near the pedal groove, below and slightly back of the right eye-peduncle. Right eye peduncle retracted between branches of genitalia. Kidney long and narrow.

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In *T. castra* and *T. timorensis* (pl. 9, fig. 31) the duct of the spermatheca is very long. In all other features of genitalia, jaw and teeth, they resemble the typical Trochomorphas. The length of this duct may warrant the retention of the section *Sivella* Blanf.

Jaw arcuate, smooth, with a small median projection, or none. (Pl. 8, fig. 10, *T. assimilis;* pl. 7, fig. 13, *T. planorbis;* pl. 9, fig. 30, *T. timorensis.*)

Radula: *Central and lateral teeth having the strong mesocones projecting well over the posterior borders of their basal-plates, and lacking ecto- and entocones.* Outer lateral teeth at first sinuated outside, the sinuation increasing to a denticle on the transition teeth, and *ascending on the mesocone to form the long bifid cusps of the marginal teeth,* which become very oblique (pl. 8, fig. 11, *T. assimilis,* central, lateral and transition teeth, with several adjacent marginals and an outer marginal drawn). See also fig. 18, *T. subtrochiformis,* showing central and 1st, 12th, 13th and 24th teeth.

Of the names quoted in the reference paragraph above, none antedates *Trochomorpha* except v. Hasselt's *Geotrochus,* dating from 1823; but as the species included by the Dutch author were not described nor figured, and in fact remained unrecognized until v. Martens identified them by the aid of v. Hasselt's unpublished drawings, his names cannot have precedence for either genus or species.

The prominent features of this genus are its simply conical or lens-shaped, smooth shell, with toothless aperture and non-expanded lip; the undivided sole of the foot, bordered above by parapodial grooves, without caudal mucus gland; the simple genitalia; smooth jaw; and unicuspid central and lateral, and bifid, *Nanina*-like marginal teeth.

Our knowledge of the anatomy of this genus hitherto has been due to Semper's investigations. Gould has given figures of the living animal of *tentoriolum, troilus* and *coniformis,* and Quoy and Gaimard figure that of *solarium.* All of these figures agree with my own observations and figures of *T. assimilis* Grt., from which the above account is mainly drawn. Wiegmann has recently dissected a specimen of *T. planorbis* Less. (Webers' Zool. Ergebnisse einer Reise in Niederländisch Ost-Indien, iii, p. 152, 1893). This species shows the lower portion of the vas deferens to be dilated beyond the apex of the penis, where the retractor muscle is inserted (pl. 7, figs. 14, 15, showing penis, etc. from both sides). The vagina is much

swollen between the lower end of the uterus and the opening of the spermatheca duct, and at the upper end of this swollen portion there is inside a whitish gland formed of one-celled club-shaped follicles (pl. 7, fig. 14a). This internal vaginal gland has not been noticed in other species. Stoliczka has published the anatomy of *T. castra* and *T. timorensis* (Journ. As. Soc. Beng. xlii), finding these species to have the structure of typical Trochomorpha except for the very long duct of the spermatheca.

The genus *Trochomorpha* inhabits a vast area, and is excessively prolific in specific and varietal forms. Its range extends from India, central China and the Liu Kiu Is. on the north, southward to New Guinea, the Louisiades and New Hebrides, and east to the Society Islands. It is not known to occur in Australia, New Caledonia, or any island having the Australo-Zealandic fauna, such as Norfolk and Lord Howe. The species are in many cases founded upon slight differences, and may become subject to some reduction as our knowledge of their variation increases. For the present, it is necessary to use great care in their description; the width of umbilicus compared with that of the base should always be stated. The only genus with which species of *Trochomorpha* are likely to be confused is the East Asian group *Plectotropis;* this however differs in the dilated columellar lip of the shell, etc.

Subdivisions.

Trochomorpha may be divided into three sections: (1) TROCHOMORPHA s. str. (of which *Nigritella* is a synonym), containing the solid, opaque, trochiform species, mainly Polynesian, (2) VIDENA Ads. for depressed, acutely keeled, thin shelled forms, with wide umbilicus, and (3) SIVELLA Blanf. for species having the shell like *Videna*, but with a very long duct to the spermatheca.

The species of *Videna* occupy the entire area inhabited by the genus, but are especially characteristic of the Philippines and east Indies generally. *Sivella* is an Indo-Chinese group.

Systematic position.

The family relationships of *Trochomorpha* have been variously estimated; v. Martens (Albers, edit. 2) placing it under *Nanina* as a subgenus, while Pfeiffer (Nomencl. Hel. Viv.) considers it a genus between *Leucochroa* and *Patula*. Semper also places it among the true Helices. The facts at present known incline me to view

Trochomorpha as a somewhat aberrant genus of *Zonitidæ;* and as such it can properly claim no place in this volume. *It is a significant fact, that,* so far as I know, *all Zonitidæ which possess a bifid cusp upon the marginal teeth, form it by the elevation of the ectocone upon the mesocone, while in those Helicidæ having a long bifid inner cusp on the marginals it is formed by the union of the entocone with the mesocone.* One of the earliest modifications of the Zonitid stock was the loss of entocones from the marginal teeth; but in the Helicoids they persist in most genera.

Species of India, China, Farther India and adjacent islands.

T. benigna Pfr. iii, 84.
T. borealis Mlldff. viii, 119, 133.
T. cantoriana Bens. iii, 83.
T. caryx Bens. iii, 75.
T. castra Bens. iii, 84.
v. galerus Bens. iii, 75.
T. fritzei Bttg. viii, 194.
T. haenseli Sch. & Bttg. viii, 119.
T. paviei Morl. iii, 82.
T. percompressa Bens. iii, 84.
T. saigonensis Crse. iii, 84.
T. sapeca Heude.
T. shermani Pfr. iii, 84.
T. subtricolor Mab. viii, 134.
T. timorensis Mts. iii, 83.
thieroti Morg. viii, 133.
T. tonkinorum Mab. viii, 120.

Species of Andaman and Nicobar Is.

T. billeana Mörch, iii, 84.
T. iopharynx Mörch.
T. kjellerupi Mörch. iii, 74.
T. sanis Bens., iii, 84.
T. subnigritella Bedd. viii, 127.
T. sulcipes Mörch. iii, 84.

Philippine Island species.

T. acutimargo Pfr. iii, 85.
T. albocincta Pfr. iii, 86.
T. bagoensis Hid. viii, 134.
T. beckiana Pfr. iii, 86.
v. kierulfii Mörch. iii, 86.
T. bintuanensis Hid. viii, 134.
T. boettgeri Mlldff. viii, 134.
T. conomphala Pfr. iii, 84.
T. costellifera Möll. viii, 125.
T. crossei Hid viii, 134.
T. curvilabrum Rve. iii, 86.
T. gouldi Pfr. iii, 77.
T. granulosa viii, 125.
T. luteobrunnea Möll. viii, 120.
splendens Hid. non Semp.
T. metcalfei Pfr. viii, 121.
solaroides Rv. iii, 85.
T. neglecta Pils. viii, 124.
T. quadrasi Hid. viii, 122.
stenogyra Mlldff.
T. radula Pfr. iii, 85.
T. repanda Möll. viii, 123.
T. rufa Mlldff. viii, 133.
T. sibuyanica Hid. viii.
T. splendens Semp. viii, 123.
T. splendidula Möll. viii, 123.

T. infanda Semp. viii, 120.
T. loocensis Hid. viii, 120.
T. stenozona Mlldff. viii, 133.
T. strigilis Pfr. iii, 85.

Species of Java, Celebes and the Moluccas.

T. bicolor Marts. iii, 82.
T. concolor Bttg. viii, 126.
T. ? costulata Marts.
T. gorontalensis Mts. iii, 83.
T. hartmanni Pfr. iii, 83.
T. planorbis Less. iii, 82.
syncœcia Mlldff. viii, 133.
v. appropinquata Marts. iii, 82.
v. lessonii Marts. iii, 82.
v. javanica Marts. iii, 82.
v. nummus Issel. iii, 82.
T. planorbis Less.
v. lardea Mts. iii, 83.
zollingeri Mouss. not Pfr.
T. sculpticarina Marts. iii, 80.
T. staudingeri Anc. viii, 134.
T. strubelli Bttg. viii, 126.
zonatus v. Hasselt.
T. ternatana Guill. iii, 76.
v. batchianensis Pfr. iii, 76.
T. tricolor Marts. iii, 83.
T. zollingeri Pfr. iii, 82.

Species of New Guinea and dependencies.

T. exclusa Fér. iii, 85.
T. infrastriata Sm. iii, 80.
T. lomonti Braz. iii, 82.
T. morio Canefri, viii, 128.
T. nigrans Sm. viii, 128.
v. cornea Hedl. viii, 296.
T. papua Less. iii, 89.
T. solarium Q. & G. iii, 80.

Species of the Solomon and New Hebrides groups.

T. apia Jacq. iii, 88.
T. belmorei Cox. iii, 76.
T. catinus Pfr. iii, 74.
T. convexa Hartm. viii, 131.
T. crouanii Guill. iii, 90.
T. crustulum Cox. iii, 90.
T. deiopeia Ang. iii, 89.
T. eudora Ang. iii, 88.
T. exaltata Pfr. iii, 76.
T. fatigata Cox, iii, 76.
T. gassiesi Pfr. iii, 89.
T. godeti Sowb. viii, 129.
T. henschei Pfr. viii, 130.
T. juanita Ang. iii, 77.
T. matura Pfr. iii, 88.
T. meleagris Pfr. iii, 81.
v. sebacea Pfr.
cerealis Cox.
thorpeiana Braz.
T. membranicosta Pfr. iii, 76.
T. merziana Pfr. iii, 89.
T. partunga Ang. iii, 81.
T. rhoda Ang. iii, 88.
T. rubens Hartm. viii, 129.
T. sanctæannæ Sm. iii, 89.
T. scytodes Pfr. iii, 77.
T. semiconvexa Pfr. iii, 88.
T. serena Cox. iii, 77.
T. xiphias Pfr. iii, 89.
T. zenobia Pfr. viii, 131.

Polynesian species, Pelew to Marquesas groups.

T. abrochroa Crse. iii, 90.
v. pseudoplanorbis Mouss. iii, 91.
T. accurata Mouss. iii, 80.
T. alta Pse. iii, 73.
T. approximata Guill. iii, 90.
T. assimilis Garr. iii, 92.
T. concentrica Guill. iii, 81.
T. contigua Pse. iii, 78.
congrua Pse. not Pfr.
T. corallina Mouss. iii, 93.
T. cressida Gld. iii, 91.
vahine H. & J.
T. electra Semp. iii, 86.
T. entomostoma H. & J. iii, 79.
T. eurydice Gld. iii, 90.
T. fessonia Ang. iii, 79.
T. fuscata Pse.
T. goniomphala Pfr. iii, 78.
T. kantavuensis Garr. viii, 127.
T. küsteri Pfr. iii, 80.
T. latimarginata Sm. iii, 92.
T. lüdersi Pfr. iii, 92.
T. luteocornea Pfr. iii, 90.
T. marmorosa H. & J. iii, 90.
T. merzianoides Garr. viii, 132.
T. navagatorum Pfr. iii, 90.
T. nigritella Pfr. iii, 78.
v. oppressa Pse. iii, 78.
T. oleacina Semp. iii, 77.
T. pagodula Semp. iii, 77.
T. pallens Pse. iii, 91.
T. planoconus Mouss. viii, 132.
T. prostrata Pse. iii, 93.
T. rectangula Pfr. iii, 73.
hapa H. & J.
T. samoa H. & J. iii, 81.
T. sansitus Cox. iii, 81.
T. subtrochiformis Mouss. iii, 79.
v. albostriata Mouss.
T. swainsoni Pfr. iii, 91.
v. lenta Pse.
v. scuta Pse.
T. taviuniensis Garr. viii, 133.
T. tentoriolum Gld. iii, 79.
T. themis Garr. viii, 134.
T. transarata Mouss. iii, 79.
T. trochiformis Fér. iii, 79.
circumdata Mühl.
T. troilus Gld. iii, 92.
T. tuber Mouss. iii, 81.
T. tumulus Gld. iii, 91.

Species of unknown habitats.

T. conferta Pfr. iii, 81.
T. hidalgoana Crse. iii, 93.
T. pagodula Pfr. iii, 73.
T. planissima Pfr. iii, 93.
T. rudiuscula Pfr. iii, 93.
T. securiformis Dh. iii, 78.
T. valenciennesii Guill. iii, 93.
guilloui Pfr.
T. virgulata Sowb. iii, 77.

Genus PUNCTUM Morse, 1864.

Punctum Morse, Obs. on the Terrest. Pulm. Maine, Journ. Portl. Soc. Nat. Hist. 1864, p. 27. Type *P. minutissimum* Lea.—See also Binney, Second Suppl. Terr. Moll. v, Bull. Mus. Comp. Zool. xiii, no. 2, t. 3, f. 4, 6.—Schako, Mal. Blätter xx, p. 178, f. *A–D.*—

JICKELI, Fauna der Land- und Süsswasser Moll. N.-O. Afrika's, in Verh. K. Leopoldinisch-Carolinisch Deutschen Akad. der Naturforscher, xxxvii, p. 54, t. 1, f. 4.

Shell minute, thin, subdiscoidal but with convex spire, openly umbilicated; unicolored; whorls about 4, convex, the apical 1½ smooth, rather distinctly demarked from the following whorls, which have oblique striæ or irregular riblets and excessively fine spiral striæ; the last whorl cylindrical, not descending in front. Aperture lunate, rounded; lip simple, thin. Type *P. pygmæum* var. *minutissimum*, pl. 1, figs. 11, 12, 13.

Jaw arcuate or horse-shoe shaped, composed of numerous (13–19) separate rhomboidal plates, more or less overlapping, the outer imbricating over the inner plates; the median two or three plates slightly separated, not overlapping.

The individual plates are composed of vertical chitinous fibers forming a fringe at the edges (fig. 6, 7, *P. pygmæum*); the plates are bound together by a thin transparent membrane. The number of plates varies somewhat, *P. pygmæum* (fig. 6) having 19 (*Schako*); *P. pygmæum* var. *minutissimum* having 16 (*Morse*); *P. conspectum* (fig. 9) having 14 to 16, *P. cryophilum* (fig. 5) having 13 plates.

Radula rather long and narrow; teeth rather separated, not in the least overlapping. Central tooth tricuspid, the mesocone longest, but not as long at the narrow basal-plate, side cusps small. Lateral teeth having wider rhombic basal-plates and bicuspid, the mesocone having a longer cusp. Marginal teeth not differentiated in any way from the laterals, but becoming lower with shorter cusps (pl. 1, fig. 8, *conspectum*.)

The number of transverse rows of teeth is 75 in *P. conspectum*, the formula 17–1–17 (*Pilsbry*); in *P. pygmæum* there are 114 rows of 19–1–19 teeth (*Schako*); in *P. pygmæum* var. *minutissimum*, Morse counted 54 rows of 13–1–13 teeth; in *P. cryophila* there are 75 rows of 16–1–17 teeth, according to Jickeli. Each transverse row bends forward in the middle, as shown in the line above fig. 8, representing the curve of a half row.

Distribution: North America, Europe, northern Asia and northeastern Africa.

This genus differs from the other Patuloid Helices in having the jaw composed of broad rhombic plates which are not in the least soldered together, and in the peculiar form of the bicuspid lateral teeth. It is evidently a type of vast antiquity, and probably has

actual affinity to the Neozealandic genus *Laoma*; both may perhaps be regarded as remnants of a Palæozoic fauna.

The minute species of *Discus*-like shells must all be re-examined with especial reference to the characters of the jaw before a complete list of the species of *Punctum* can be made. It is not unlikely that *micropleuros* Paget, *elachia*, *debeauxiana*, *poupillieri*, *aucapitaineana* and *massoti* Bgt., etc., will be found to belong here. For the present it seems the wisest course to group in *Punctum* only such species as are known to have the characteristic anatomical features of that genus, leaving unexamined minute Patuloid forms in *Patulastra*.

The species of *Punctum* live upon rotten or decaying logs in forests.

P. pygmæum Drap. iii, 29.
schwerzenbachiana Calc.
v. minutissimum Lea.
P. conspectum Bld. ii, 203.
P. cryophilum Mts. iii, 32.

Genus LAOMA Gray, 1849.

Laoma GRAY, Proc. Zool. Soc. Lond. 1849, p. 167; type *Bulimus?* (*Laoma*) *leimonias*.—*Phrixgnathus* HUTTON, Trans. N. Z. Inst. xv, p. 136, 1882; types *H. fatua*=*P. celia* Hutt., and *P. marginatus* Hutt.—See also HUTTON, Tr. N. Z. Inst. xvi, p. 168.—SUTER, Tr. N. Z. Inst. xxiii p. 92 and xxiv, p. 297.

Shell more or less trochiform, thin, perforate or umbilicate, the periphery keeled, at least in the young; horn-colored, striped radially with tawny. Aperture rhombic, provided with entering lamellæ, or without them; lip thin, simple. Type *L. leimonias* Gray, pl. 1, fig. 1.

Animal heliciform, the mantle subcentral, its edge slightly reflected over the peristome; no locomotive disc nor mucus pore.

Jaw arcuate, composed of 20 to 24 rhombic or oblong plates which are hairy-papillose and fringed at the upper and lower margins (pl. 1, fig. 4, *L. glabriuscula* Pfr.)

Radula having the central tooth rather narrow, unicuspid (or tricuspid), the mesocone much shorter than the basal-plate. Lateral teeth wider, rectangular, with two cusps which are either subequal or the inner one larger. Marginal teeth low, wide, with two short cusps, becoming obsolete on the outermost teeth (pl. 1, fig. 3, *L. glabriuscula*; pl. 1, fig. 2, *L. acanthinulopsis*.)

The number of teeth in a transverse row is 35.1.35 in *L. marginata*, 21.1.21 in *acanthinulopsis*, 26.1.26 in *marina*; the last named species has 110 straight transverse rows.

Distribution: All of the species known to belong to this genus inhabit New Zealand and Tasmania. Two sections may be distinguished:

Section *Laoma* Gray, *s. str.* Aperture provided with an entering lamella upon the columella only, or with lamellæ upon columella, parietal wall and outer and basal lips (pl. 1, fig. 1, *L. leimonias*). The writer has examined specimens of all of the species; *L. pœcilosticta* froms a transition to *Phrixgnathus.*

Section *Phrixgnathus* Hutton. Shell and animal the same as in *Laoma*, except that the aperture has no teeth or folds within. (Type *L. celia* Hutt., pl. 1, fig. 10). This name cannot be used in a generic sense on account of the priority of Gray's *Laoma.* The mere absence of aperture-teeth is, of course, not sufficient for generic distinction.

The fibrous jaw, composed of rhombic plates bound together by a thin membrane only, and the peculiar bicuspid side teeth, agree exactly with the genus *Punctum*; and upon these grounds the two genera were associated by the writer, forming the group *Polyplacognatha* (Proc. Acad. Nat. Sci. Phila. 1892, p. 403.)

(Section *Laoma* Gray.)

L. leimonias Gray, iii, 68.
L. pœcilosticta Pfr. iii, 68.
pœcilocostata Pfr. *olim.*
L. marina Hutt. viii, 57.
nerissa Hutt.
L. pirongiaensis Sut.

Section *Phrixgnathus* Hutt.

L. mariæ Gray. iii, 37.
umbraculum Pfr.
L. conella Pfr. viii, 58.
L. ariel Hutt. viii, 59.
L. marginata Hutt. viii, 60.
L. celia Hutt. viii, 60.
L. regularis Pfr. iii, 37.
L. erigone Gray, iii, 37.
heldiana Pfr.
L. microreticulata Sut. viii, 63.
L. pumila Hutt. viii, 63.
L. raricostata Sut. viii, 100.
L. allochroida Sut. viii, 63.
v. sericata Sut. viii, 64.
v. lateumbilicata Sut. viii, 64.
L. campbellica Filh.
L. phrynia Hutt. viii, 61.
L. fatua Pfr.
L. glabriuscula Pfr. iii, 37.
L. sciadium Pfr.
L. titania Hutt. viii, 62.
L. haasti Hutt. viii, 62.
L. acanthinulopsis Sut. viii, 61
L. transitans Sut. viii, 59.

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(*Tasmanian Species.*)

L. cæsa Cox. iii, 261.
cæsus Cox.
v. occulta Cox. iii, 264.
L. henryana Pett.
L. pictilis Tate.

Genus FLAMMULINA Martens, 1873.

Flammulina Mts., Crit. List Moll. N. Z., p. 12.—
Gerontia Hutton, Trans. N. Z. Inst. xv, p. 135.—Pilsbry, Nautilus vi, p. 55; Manual viii, p. 64.—Family *Phenacohelicidæ* Suter, Trans. N. Z. Inst. xxiv, p. 270, 1892.

Shell thin, varying from discoidal to subtrochiform, umbilicated or perforated, the perforation sometimes closed; generally somewhat translucent; surface striate or ribbed, often decorated with reddish flammules. Embryonal 1–1½ whorls smoother, often spirally striated. Aperture rounded lunar, lacking folds, teeth or internal callus; the lip thin and simple, somewhat dilated at the columella.

Animal with a narrow foot bearing a mucous gland at the tail, sometimes surmounted by a papilla. Genitalia unknown; mantle subcentral, its margin even, and slightly reflexed over the peristome of the shell.

Jaw delicate, composed of thin vertical laminæ firmly soldered together but showing more or less of the overlapping edge of each plate.

The radula exhibits a considerable amount of variation in the different species, but the extremes are connected by all intermediate forms. That of *F.* (*Thalassohelix*) *ziczac*, drawn by the author from an Auckland specimen, on pl. 3, fig. 28, may be taken as an example.

The central tooth has a moderate or long mesocone, ectocones being entirely lacking in some forms, present and well developed in others. The laterals are not crowded, and generally have a long mesocone and short ectocone, but often the entocones also are developed, making the tooth tricuspid. The marginals are formed by the shortening of the basal-plate and increase in size and obliquity of the cusps, the mesocone in most forms remaining distinctly larger, sometimes becoming bifid, probably by fusion with the entocone. The ectocone persists on the marginal teeth, either as a simple cusp, as in *F. ziczac*, or becoming split into several distinct points, as in the *Allodiscus* species, and in the latter the tooth becomes very wide. In one subgenus, *Phacussa*, the ectocone is lost on the marginals, but they retain the characteristic rhomboidal basal-plate; and *Thalassohelix* exhibits a form of marginals connecting *Phacussa* with the more normal

Flammulinas. *In no case does the ectocone unite with and ascend the mesocone on the marginals* as is the case in all genera of *Zonitidæ* which retain ectocones upon the marginal teeth.

Distribution, New Zealand, New Caledonia, Lord Howe Island, Australia and Tasmania.

A group of rather small shells differing from *Zonitidæ* in the forms of the marginal teeth of the radula and the plaited jaw, and from *Endodonta* and its subdivisions in the possession of a well developed caudal mucous gland. The numerous species have been distributed into many groups which are considered genera by some authors, but which intergrade so closely in all essential characters that I am compelled to class them as sections or at most subgenera. Their differential characters seem no more generic than those distinguishing *Tachea*, *Macularia* and *Pomatia* among European Helices, or *Mesodon*, *Triodopsis* and *Stenotrema* among American. Genera should, it is believed, be founded upon really tangible structural differences, either in shell, animal or both; and such differences these groups do not seem to possess. They are however of value as subgeneric divisions. The investigation of the genitalia may lead to more satisfactory results, but I expect to find but little differentiation within the genus.

Our knowledge of these forms and their anatomy is mainly due to Professor F. W. Hutton and Mr. H. Suter, who have investigated the dentition of a majority of the New Zealand species. See Hutton, in Trans. N. Z. Inst. xiv, xv, and xvi, and Suter, in Tr. N. Z. Inst. xxiii and xxiv. Messrs Hedley and Suter have revised the nomenclature in Proc. Linn. Soc. N. S. Wales (2) vii.

The characteristics of *Flammulina* may warrant the surmise that they have been modified to occupy in New Zealand the place filled in the economy of nature by *Zonitidæ* in other regions. If this be true, the anomalous dentition of *Phacussa* must be regarded as a recent adaptive modification.

For the generic title of this group the writer, in 1892, selected Hutton's name Gerontia, this being the oldest designation proposed for species then known to him to belong to the genus. There are, however, three prior names, *Flammulina* Martens, which being the earliest is now adopted, and *Monomphalus* and *Rhytidopsis* of Ancey, which are also believed to apply to members of this genus. The presence of a caudal mucous-secreting gland, however, has not been ascertained in the species of these New Caledonian groups, so that their relationship to *Flammulina* is uncertain.

The following sectional or subgeneric divisions may be distinguished:

Phacussa Hutt., p. 12.
Thalassohelix Pils., p. 12.
Gerontia Hutt., p. 14.
Allodiscus Pils., p. 14.
Pyrrha Hutt., p. 15.
Therasia Hutt., p. 15.
Phenacohelix Sut., p. 16.
Flammulina Mart., p. 17.
Suteria Pils., p. 17.
Hedleyoconcha Pils., p. 18.
Monomphalus Anc., p. 19.
Rhytidopsis Anc., p. 20.

Subgenus PHACUSSA Hutton, 1883.

Phacussa HUTTON, Trans. N. Z. Inst. xv, p. 138 (proposed for *Zonites (?) helmsi* and *fulminata*.)

Shell depressed, umbilicated; the spire convex, periphery rounded. Whorls striate or with fine ribs, the apical 1½ whorls smooth. Aperture rounded-crescentic, peristome simple. Type *F. helmsi* Hutt. (pl. 3, figs. 10, 11, *F. hypopolia* Pfr.)

Animal elongated; foot very narrow and long, compressed, not tapering, truncated posteriorly and with a caudal gland; mantle slightly reflected; eye peduncles long and thick, tentacles moderate (*Hutton, Ph. helmsii.*)

Jaw arcuate, slightly tapering toward the ends, with numerous flat imbricating vertical plaits (20–25 in *helmsi*, about 45 in *hypopolia*) which denticulate the margins (pl. 2, figs. 2, 3, *F. hypopolia.*)

Dentition: About 110 nearly straight transverse rows of 15–11–1–11–15 to 17–13–1–13–17 teeth. Central tooth with a wide mesocone and minute ectocones. Lateral teeth tricuspid, the entocone minute, obsolete on the outer ones. Marginal teeth having the basal-plate subquadrate, mesocone very long and oblique, lacking side cusps (pl. 2, fig. 1, *F. hypopolia.*)

Distribution, New Zealand. The shell in this group is very similar to that of *Phenacohelix*, but the marginal teeth lack side cusps, the mesocone being strongly developed, giving it a Zonitoid aspect.

F. helmsi Hutt.
v. maculata Hutt.
F. hypopolia Pfr. ii, 181.
F. fulminata Hutt.

Subgenus THALASSOHELIX Pilsbry, 1892.

Thalassohelix PILS., The Nautilus, Sept. 5, 1892, p. 56, type *H. zelandiæ* (Gray) Hutton.—*Thalassia* of HUTTON and other New Zealand authors.—Not *Thalassia* ALBERS, Die Hel. 1860, p. 59. Not *Thalassia* Chevrolat, 1834, a genus of Coleoptera.

Shell umbilicated, thin, depressed or trochiform, the periphery acutely keeled (*zelandiæ*), bluntly angled (*obnubila*), or rounded

(*ziczac*). Apical whorls most minutely spirally striated or smooth. Aperture rather large, lip thin, simple, subreflexed at columella. Type *F. zelandiæ*, pl. 3, fig. 29.

Animal with narrow foot bearing a caudal mucous gland with a papilla above it; mantle slightly reflected over the peristome.

Jaw arcuate, with flat plaits.

Dentition: central tooth with a short mesocone, the ectocones obsolete; laterals with a short ectocone, which disappears on the marginals, leaving a long, oblique mesocone only (pl. 3, fig. 27, *F. zelandiæ*.)

Distribution New Zealand and Tasmania. The shells included by Messrs Hedley and Suter in this division are rather dissimilar in form. The dentition resembles *Phacussa* in the prominence of the mesocones and obsolescence of ectocones on the marginal teeth, and this peculiarity also serves to distinguish *Thalassohelix* from *Therasia*, the shell of which is of similar form. Certain Tasmanian forms have recently been referred by Suter to this group,—a relationship previously suspected by the writer.

New Zealand species.

F. ziczac Gld. ii, 210.
portia Gray. ii, 213.
kappa Pfr.
collyrula Rve.
F. igniflua Rve. i, 129.
lambda Pfr.
v. obnubila Rve. i, 120.
sigma Pfr. *MS.*
F. propinqua Hutt. viii, 72.
F. zelandiæ Gray. ii, 214.
neozelanica Hutt.
v. antipoda H. & J. ii, 214.
F. aucklandica (Le Guill.) Hutt.
auklandica Guill.

Australian and Tasmanian species.

[Compiled by Charles Hedley.]

F. fordei Brazier.
allporti Legrand, iii, 263.
austrinus Cox. iii, 264.
fernshawensis Petterd.
helice Cox, iii, 261.
macoyi Petterd.
medianus Cox, iii, 264.
petterdi Cox.
positura Cox, iii, 262.
tabescens Cox.
tranquilla Cox.
F. hamiltoni Cox.
cœpta Cox. iii, 263.
ducani Cox. iii, 46.
floodi Brazier. iii, 46.
irvinæ Cox. iii, 46.
kingi Brazier. iii, 46.
langleyana Brazier.
milligani Brazier.
pascoei Brazier. iii, 46.
plexus Cox. iii, 262.
savesi Petterd. iii, 46.

F. georgiana Quoy & Gaimard.
F. trajectura Cox. iii, 264.
F. wynyardensis Petterd.
F. hamiltoni Cox.
scrupulus Cox. iii, 46.
spoliata Cox. iii, 46.
stephensi Cox. iii, 46, 262.

Subgenus Gerontia Hutton.

Gerontia Hutton, Trans. N. Z. Inst. xv, p. 135.—*Gerentia* (typog. err.) in N. Z. Journ. of Sci. i, p. 476.

Shell *depressed and openly umbilicated, having the contour of Patula;* thin, rather fragile, the surface delicately sculptured with fine cuticular riblets. Apical whorl minutely granular, or showing a few weak spirals, having a minute perforation at the tip. Type *F. pantherina* Hutton, pl. 3, figs. 1–3.

Animal heliciform, mantle rather posterior, included; tail acute with a mucous pore but no papilla.

Jaw vertically striated (pl. 2, fig. 5, *F. pantherina.*)

Dentition: central teeth tricuspid, cusps with moderate cutting points. Laterals similar, but the ectocones larger than the entocones; transition teeth bicuspid by fusion of entocone with mesocone. Marginals with a broad bifid cusp (pl. 2, fig. 4, *F. pantherina.*)

The shell is like a thin *Selenites* with delicate close riblets. It is more broadly umbilicated than in the other subgenera of this genus. The two species are from New Zealand.

F. pantherina Hutt. viii, 65.
F. cordelia Hutt. viii, 66.

Subgenus Allodiscus Pilsbry, 1892.

Psyra Hutton, Trans. N. Z. Inst. xvi, p. 201, 1884. First species *P. dimorpha.* Not *Psyra* Stal, 1876.—*Allodiscus* Pilsbry, Nautilus vi, p. 56, Sept. 5, 1892; Man. Conch. (2), viii, p. 66.

Shell thin, orbicular and *depressed, with low or flat spire, rounded periphery, and narrow or subimperforate umbilicus*; surface radially rib-striated, *not hairy,* the embryonic 1½ whorls spirally striated (pl. 3, fig. 12, *F. tullia*). Aperture crescentic scarcely oblique; peristome thin, shortly reflexed at the columella; parietal wall nude. Type *H. dimorpha* Pfr. (See pl. 3, figs. 4, 5, 6, *F. planulata* Hutt.)

Jaw slightly arcuate, not tapering toward the ends, flatly ribbed or plaited (pl. 2, fig. 11, *F. tullia*; pl. 2. fig. 13, *F. godeti.*)

Dentition: central tooth with tricuspid reflection, mesocone long. Lateral teeth bicuspid, the entocone being suppressed, or tricuspid.

Marginal teeth broad, with 3 to 5 cutting points (pl. 2, fig. 14, *F. godeti*). In *F. tullia* the side cusps of the centrals are minute; inner marginals tricuspid, outer bicuspid (pl. 2, fig. 12, *F. tullia;* pl. 2, fig. 14, *F. godeti*). In *F. dimorpha* the side cusps of the central tooth are minute; the marginals have a long bifid inner cusp (mesocone, or fused mesocone and entocone), and by splitting, two ectocones.

F. dimorpha Pfr. ii, 211.
F. venulata Pfr. ii, 211.
F. cassandra Hutt. viii, 66.
F. tullia Gray. ii, 211.
F. planulata Hutt. viii, 67.
F. adriana Hutt. viii, 67.
F. miranda Hutt. viii, 68.
F. godeti Sut. viii, 68.
F. wairoaensis Sut.
F. urquharti Sut.

Subgenus Pyrrha Hutton, 1884.

Pyrrha Hutton, Trans. N. Z. Inst. xvi, p. 200.

Shell depressed-globose, thin, translucent, striated and minutely reticulated, imperforate; the periphery rounded, spire convex. Peristome simple, reflexed over the minute perforation. Type *P. cressida* Hutt., pl. 3, figs. 17, 18, 19.

Animal heliciform, mantle subcentral, reflected over the peristome with an even margin; tail truncate, with a large papilla and mucous gland.

Jaw arcuate, flatly ribbed (pl. 2, fig. 9, *F. cressida.*)

Dentition: central tooth with the mesocone only developed. Laterals bicuspid, the entocones suppressed. Marginal teeth with several cusps (pl. 2, fig. 10, *F. cressida.*)

The single species inhabits New Zealand.

G. cressida Hutton, viii, 72.

Subgenus Therasia Hutton, 1883.

Therasia Hutt., N. Z. Journ. of Sci. i, p. 477 (proposed for *tamora, valeria* and *thaisa.*)

Shell depressed, perforate or umbilicate, thin, with conoidal spire; the periphery angular or subangular; aperture round-lunar; lip thin, slightly reflexed at the columella. Surface striated. Embryonic whorls spirally striated. Type *T. thaisa* Hutton, pl. 3, figs. 14, 15, 16.

Resembles *Allodiscus* in the dentition, and the spirally striated apex of the shell, but differs in the form and sculpture of the latter, which is much as in section *Thalassohelix.*

Animal elongated; mantle subcentral, included; foot long and narrow, reaching beyond the shell, rounded behind, slightly truncated, and with a mucous gland situated under a caudal papilla (Hutton, *F. thaisa.*)

Jaw membranaceous, arcuate (*F. thaisa*) or horse-shoe shaped (*F. decidua*, pl. 2. fig. 19), with broad imbricating plates.

Dentition: central teeth narrow, with small reflection, the mesocone long; ectocones hardly visible. Lateral teeth with larger reflection, the inner ones without side cusps, the outer tricuspid. Marginal teeth in *thaisa* (pl. 2, fig. 21) multicuspid; in *decidua* (fig. 20) first bicuspid, then tricuspid, rounded at the anterior margin; the outer 2 or 3 marginals are bicuspid.

Distribution: New Zealand.

F. celinde Gray. ii, 211.
F. valeria Hutt. viii, 69.
F. ophelia Pfr. ii, 211.
F. tamora Hutt. viii, 70.
F. thaisa Hutt. viii, 70.
F. decidua Pfr. viii, 71.
F. traversi Smith, ii, 214.

Subgenus PHENACOHELIX Suter, 1892.

Phenacohelix SUTER, Trans. N. Z. Inst. xxiv, p. 270.—*Fruticicola* HUTTON, *olim*, not of Held.

Shell *depressed, umbilicated*, subdiscoidal, the spire slightly convex or conoidal, *periphery broadly rounded.* Whorls finely ribbed, the apical one smooth except for microscopic spiral striæ. Aperture lunate, the lip simple. Type *F. pilula* Rve., pl. 3, fig. 13.

Animal elongated, the foot narrow, projecting behind the shell; mantle subcentral, rather anterior, included; eye peduncles long, rather clavate; tentacles moderate. Hutton, from whose paper the above description of the animal of *F. granum* is quoted, does not mention a caudal mucous pore, but it is doubtless present.

Jaw arcuate, with about 35 flat ribs which indent the concave but not the convex margin (pl. 2, fig. 6, *F. pilula.*)

Dentition: central tooth with small side cusps (*F. granum*) or none (*F. pilula*); laterals similar, lacking entocones. Marginal teeth multicuspid, the inner cusp larger (pl. 2, fig. 7, *F. pilula.*)

Distribution, New Zealand. The shell is very like that of *Phacussa* but the marginal teeth differ widely.

F. pilula Rve. ii, 212.
iota Pfr.
F. granum Pfr. ii, 212.
F. chordata Pfr.

Subgenus SUTERIA Pilsbry, 1892.

Suteria PILS., The Nautilus, Sept. 5, 1892, p. 56, type H. *ide* Gray.—*Charopa* HUTTON, *olim*, not Albers.—*Patulopsis* SUTER, Trans. N. Z. Inst. xxiv, p. 270, 1891, type *H. ida* Gray; not *Patulopsis* Strebel, 1879, a Mexican group of *Zonitidæ*.

Shell thin and rather opaque, *openly umbilicated; discoidal, the spire flat; periphery broadly rounded.* Surface having low spirals, and *radial, undulating cuticular lamellæ bearing hairs*; 1½ apical whorls smooth. Lip thin, simple. Type *H. ide* Gray, pl. 3, figs. 24–26.

Animal rather short and narrow; mantle subcentral, rather anterior, slightly reflexed over the peristome of the shell; foot narrow, extending behind the shell, the tail truncated and furnished with a mucous gland; no locomotive disc. Eye peduncles very long, cylindrical, approximate at their bases; tentacles long. (*Hutton* for *H. ide.*)

Jaw with 30 flat plaits, each transversely striated.

Dentition: centrals tricuspid, the mesocone long, ectocones short and constricted on the outer sides. Lateral teeth similar, but the entocone smaller than the ectocone. Inner marginals with one bifid cusp, the outer with several subequal cusps (pl. 2, fig. 8, (*F. ide.*)

The principal feature of the umbilicated discoidal shell is its *hairy, undulating ribs.* The dentition is characterized by the presence of entocones on the lateral teeth; but *Gerontia pantherina, Allodiscus planulata* and other forms have this same feature. The single species is from New Zealand.

F. ide Gray. ii, 210.

ida auct.

Subgenus FLAMMULINA v. Martens, 1873.

Flammulina MART., Critical List of N. Z. Moll., p. 12.—HEDLEY & SUTER, Proc. Linn. Soc. N. S. Wales, (2) vii, p. 643, 1892.—*Amphidoxa* of N. Z. authors, not of Alb.—*Calymna* HUTTON, Tr. N. Z. Inst. 1884, p. 199, not of Hübner, 1816.

Shell narrowly umbilicated or imperforate, globose or depressed, thin, fragile, subpellucid, composed of few rapidly widening whorls, which are either smooth and glossy or striated. Aperture large, rounded-lunar; lip thin, simple, slightly expanded at the columellar insertion. Type *F. zebra* Le Guill., pl. 3, fig. 23.

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Animal carrying the shell subcentrally, mantle edge slightly reflected over the peristome of the shell, with an even margin; tail depressed, rounded, with a mucous gland (*Hutt.*)

Jaw delicate, more or less arcuate, with numerous vertical plaits, which generally crenulate the lower margin (pl. 2, fig. 14, *F. corneofulva.* Pl. 2, fig. 18, *F. chiron.*)

Dentition: Rhachidian teeth with the mesocone well developed, ectocones small (absent in *corneofulva*). Lateral teeth similar to the central. Marginal teeth tricuspid (sometimes 4-cuspid), in some species the cusps coalescing on the outer teeth (pl. 2, fig. 16, *F. corneofulva.* Pl. 2, fig. 17, *F. chiron.*)

Distribution: New Zealand and Lord Howe Island.

The contour of the shell is between *Hyalina* and *Vitrina*, and in texture it is nearly as fragile as the latter. Both striped and unicolored species occur. In typical *Flammulina* the surface is smooth and polished. In the section *Calymna* Hutton (Tr. N. Z. Inst. xvi, p. 199, 1884), the surface is finely striated. Pl. 3, figs. 20–22 represent *G. costulata* Hutt., the type of *Calymna.*

F. compressivoluta Rv. i, 128.
omega Pfr.
F. cornea Hutt. viii, 75.
F. zebra Le Guill. viii, 76.
phlogophora Pfr.
flammigera Pfr.
multilimbata H. & J.
F. jacquenetta Hutt. viii, 76.
F. perdita Hutt. viii, 76.
F. crebriflammis Pfr. i, 130.
F. corneofulva Pfr. viii, 76.
F. novaræ Pfr.
F. chiron Gray, viii, 77.
F. mastersi Braz. viii, 294.

* * *

F. costulata Hutt. viii, 73.
F. lavinia Hutt. viii, 74.
F. olivacea Sut. viii, 75.
F. feredayi Sut. viii, 74.
v. glacialis Sut.

Subgenus Hedleyoconcha Pilsbry, 1893.

Shell perforated, trochiform, keeled, thin, with oblique riblets and minute spiral lines. Aperture angulate-lunate, peristome simple, thin, slightly expanded at the columella. Type *H. delta* Pfr.

Animal 13 mill. in length, color white almost translucent; posterior part of body sharply keeled, *terminating in a mucous gland; a shallow furrow starts from the end of the tail and runs forward on each side* to the lips, the surface below this furrow being smooth, above it

finely tuberculate. Tentacles moderately long, cylindrical. Habits very active; emitting, when crawling, abundance of transparent mucous. Pl. 9, fig. 27.

Jaw low, arcuate, the ends rounded, recurved; with a blunt median projection below; crossed by numerous fine folds (pl. 9, fig. 28.)

Dentition: all teeth having basal-plates of the usual quadrate form. Centrals tricuspid, the mesocone projecting beyond the lower margin of the basal-plate, side cusps not quite reaching half the length of the plate. Inner laterals similar but slightly oblique; on he outer laterals the entocone increases and the ectocone diminishes. Marginals with the basal-plate low and wide, bearing the large, subequal ento and mesocones, and a bifid or trifid ectocone; the extreme marginals having an irregularly serrated edge (pl. 9, fig. 29.)

The trochoidal shell resembles that of the keeled *Thalassohelix* species, but the low, wide and multicuspid marginal teeth offer a contrast to those of that group.

Our knowledge of the anatomy of this group is due to Charles Hedley's researches (Proc. Roy. Soc. Queensl. v, p. 152, and vi, p. 250); the figures were drawn from specimens collected on Little Nerang Creek, Queensland, where it was found abundantly on the trunks of trees.

F. delta Pfr. ii, 215.

conoidea Cox.

fenestrata Cox.

Subgenus Monomphalus Ancey, 1882.

Monomphalus . . . . Le Naturaliste 1882, p. 86 (*M. bavayi* and *heckelianus*); Ancey, Bull. Soc. Mal. Fr. v, p. 370.—Tryon, Manual i, p. 114.

Shell thin, discoidal, the spire slightly concave, umbilicus reduced to a mere chink; periphery broadly rounded. Sculptured with fine riblets, the embryonal whorl showing very fine spiral striæ. Aperture vertical, lunate, lip thin, dilated over the perforation. Type *F. rossiteriana* Crosse, pl. 3, figs. 7, 8, 9.

Soft parts unknown. Distribution, New Caledonia.

This group is very similar in shell characters to *Allodiscus*, and the two may require to be united. They are here retained separate because the anatomy of the New Caledonian forms is unknown, and may prove sufficiently different.

G. rossiteriana Crosse. i, 114.
heckeliana Crse.
G. bavayi Crosse. i, 114.
G. gentilsiana Crosse. i, 115.
G. cerealis Crosse. i, 114.
G. lifuana Montr. i, 115.

Subgenus Rhytidopsis Ancey, 1882.

Rhytidopsis . . . . . Le Naturaliste 1882, p. 85; Ancey, Bull. Soc. Mal. Fr. V, p. 371, 1888.

Shell globose-depressed, narrowly umbilicated, thin but rather strong. Whorls about 5½, slowly increasing, the last rounded at the periphery. Aperture subvertical, oblong-lunate; lip sharp, gently sinuous below, dilated at the columella. Type *H. chelonites* Crosse, pl. 6, figs. 69, 70.

Jaw widely arcuate grooved by 18 indistinct rather wide lamellæ which denticulate its cutting edge.

Lingual ribbon 1 mill. long, ½ mill. wide; teeth according to the formula 12–8–1–8–12. The central teeth are as large as the lateral, tricuspid, the side cusps small, median cusp elongated. Lateral teeth having a rudimentary entocone, a large mesocone, and a sloping bicuspid ectocone. Marginal teeth forming an angle with those of the middle field, they are spaced, gradually increasing, and bear three cusps, the entocone and mesocone being united toward their bases, the ectocone smaller.

Our knowlege of the dentition of *H. chelonites* rests upon a note by Saint-Simon, in Bull. Soc. d'Hist. Nat. de Toulouse 1880, pp. 171, 174. The jaw and teeth agree well with those of other sections of the genus *Flammulina*, but whether a caudal mucous gland is present or not remains to be ascertained. Ancey's name appeared anonymously in 1882. It is not easy to decide what effect this should have on nomenclature.

F. chelonites Cr. i, 117.
v. major Anc.
F. prevostiana Cr. i, 123.
F. corymbus Cr. i, 117.
F. (?) minutula Cr.

Genus ENDODONTA Albers, 1850.

Endodonta Albers, Die Hel., p. 89.—Martens, Die Hel. (edit. 2), p. 90. Not *Endodonta* Lansb., Notes Leyden Mus. viii, p. 108 (Coleoptera), 1886.

Shell small, varying from discoidal to trochiform, generally umbilicated; the surface striate or ribbed. Aperture varying from multidentate to toothless; peristome simple. Type, *E. lamellosa* Fér.

Animal having distinct grooves above the margins of the foot, but no caudal mucous gland. Eye peduncles club-shaped. Genital system simple, lacking all accessory appendages. Jaw delicate, vertically sparsely striated. Radula having the basal-plates of central and lateral teeth large and square; central teeth tricuspid; lateral teeth tricuspid or lacking the endocones; marginal teeth having a low, wide basal-plate, bearing 3 or 4 cusps, the endocone and mesocone generally united at base, ectocone simple or bifid.

Distribution, Australasia and Polynesia.

This genus differs from *Flammulina* (and its subgenera) in lacking caudal mucous pore, and in the striated rather than plaited jaw; from *Pyramidula* in the clavate eye-peduncles.

No one, I believe, who examines large series of the species from various regions, will claim that the groups included as sections under *Endodonta*, can be admitted as genera. They have no anatomical differential characters whatever, as far as is now known, and the shell features integrade by easy stages throughout.

The distinction between *Charopa* and *Endodonta* is of little value, on account of the degeneration of the teeth in some forms of the latter, producing species which technically fall under the former group. In this genus, therefore, as in many others (such as *Gastrodonta*, *Polygyra*, *Lucerna*, *Sagda*, etc.), the presence or absence of teeth or lamellæ within the aperture is of scarcely more than specific value, or at most, serves to define groups of no more than sectional rank.

The principal authorities upon the shells now assembled here are Pease, Garrett, Cox, Brazier, Hutton, Semper, Suter and Hedley. Mousson, Gassies, Crosse and Pfeiffer have also contributed to the literature. Notwithstanding the great amount of work which has been done, a vast field for future labor remains. The anatomy is but little known except in the New Zealand species, and very few acceptable figures of the shells have been published. In this genus, figures should be drawn of sufficient size to show clearly all features of the shell, and this cannot be done with figures much smaller than those illustrating the present work.

KEY TO SUBGENERA.

a. Aperture provided with teeth, folds or spiral liræ.
  b. Parietal callus elevated at edge into a transverse lamella; base glossy, *Brazieria.*
  bb. Teeth or lamellæ internal, spirally entering or tubercular,
    c. Form elevated conical; columella calloused, *Diglyptus.*
    cc. Form not high conic, diam. greater than alt.; no heavy columellar nodule.
      d. Umbilicus pouch-shaped, wide within, constricted at opening, *Libera.*
      dd. Umbilicus not pouch-shaped, open or imperforate, *Endodonta.*

aa. Aperture lacking teeth, internal folds or liræ.
  b. Spire elevated, the alt. nearly equalling or exceeding the diam.
    c. Shell cylindrical, pupiform, *Phenacharopa.*
    cc. Shell convex-conoidal or thimble shaped, hairy, *Aeschrodomus.*
    ccc. Shell pyramidal-conic, spirally sculptured and pitted, not hairy, *Paratrochus.*
  bb. Spire depressed, convex, flat or concave; diam. much exceeding the alt., *Charopa.*

Subgenus DIGLYPTUS Pilsbry, 1893.

Diaglyptus PILS., Manual viii, p. 86, not *Diaglypta* Fœrst., Verh. Ver. Rheinl. xxv, p. 176 (Insecta.)

? *Pitys* BECK, Index Molluscorum, p. 9, 1837 (name only), type *P. oparana* B. (undescribed).—MŒRCH, Catal. Yoldi, p. 6, 1852 (no description; *H. bilamellata* Pfr. mentioned.)

Not *Pitys* PEASE, P. Z. S. 1871, p. 450.

Shell *elevated-trochiform,* rather narrowly but openly umbilicated, *the two apical whorls spirally striated* the remaining whorls strongly obliquely ribbed. Aperture armed with a strong entering parietal lamella, and two close columellar plicæ *terminating in a large callous nodule on the columellar lip;* peristome expanded below. Type *Helix bilamellata* Pfr.,=*pagodiformis,* pl. 5, fig. 54.

Anatomy unknown. The single species inhabits the island of Opara, one of the Austral group. It was doubtless derived from the

Endodonta stock, but the elevated contour and the aperture armature render it quite distinct in aspect.

E. pagodiformis Smith. viii, 86.
bilamellata Pfr. not Sowb.
? *oparana* Beck (undesc.)

Subgenus LIBERA Garrett, 1881.

Libera GRT., Journ. Acad. Nat. Sci. Phila. (2), viii, p. 390; ix, p. 33. Not "*Cephalopoda Libera*" DEHAAN, Monographiæ Ammoniteorum et Goniatiteorum, p. 18 (1825), which was not proposed as a generic name, and is in no sense such.

Shell depressed, widely umbilicated in the young, *the umbilicus strongly constricted in adults to form a pouch-like cavity,* in which the eggs are carried. Whorls 7–9, closely-coiled, the last generally angular. Aperture subrhombic, provided with folds within; lip thin, sharp; the columellar margin dilated, emarginate. Type E. *subcavernula*, pl. 5, figs. 45, 46, 47.

Animal small, ovoviviparous; eye peduncles long and slender, tentacles small; foot short, narrow, pointed behind.

Genitalia entirely simple, lacking all accessory organs (*L. bursatella, teste* Semp. Phil. Reise, p. 135.)

Jaw of *L. bursatella* distinctly striated, narrow, as if composed of fully 20 narrow lamellæ; entirely similar to that of *P. rotundata* Müll.

Radula consisting of 15–1–15 (*recedens*) to 10–7–1–7–10 (*tumuloides*) teeth. Centrals tricuspid. *Laterals lacking the entocones* or having it excessively small. Marginal teeth having a long bifid inner cusp (entocone plus mesocone) and a small ectocone (pl. 9, fig. 34, *E. recedens* Grt.; pl. 9, fig. 26, *E. tumuloides* Grt.)

The prominent feature of this radula is the lack of entocones on the lateral teeth. The jaw corresponds exactly with that of the typical Charopas. Semper has examined the animal of *bursatella;* Binney the teeth of *tumuloides,* and I have examined the radula of *recedens.*

This group is distinguished from *Endodonta* and other toothed Patuloids by the constriction of the umbilicus. The young (pl. 5, fig. 48, *E. fratercula* Pse.) contained in the umbilical pouch consist of about 1½ rounded, ventricose whorls, which are regularly and finely rib-striate, showing no trace of spiral striæ. The figure shows

the shell seen from above. The half grown shells are widely umbilicated, and resemble the normal Endodontas in form and teeth.

This group also has descended from the *Endodonta* stock, being differentiated only by the constriction of the mouth of the umbilicus.

Garrett writes as follows. "Remarkable for their singular habit of ovipositing into the cavernous umbilicus. The eggs usually from four to six, or the same number of young shells, may frequently be seen closely packed in the cavity. The peculiar constriction of the umbilicus does not occur until the last two whorls are completed, previous to which it is very open or cup-shaped. Certain species more completely secure the safety of their eggs by the formation of a very thin shelly plate, which projects from the columellar and parietal region and nearly closes the umbilical opening. It is subsequently either broken away or absorbed by the animal to facilitate the escape of the young shells. All the species are gregarious, living under loose stones, rotten wood, and less frequently buried in decaying leaves. They range from the low lands near the sea-shore to upwards of two thousand feet above sea-level. So far as known, the genus, which comprises about a dozen species, is peculiar to the Society and Cook's Islands. In the former group they are confined to Tahiti and Moorea."

E. cavernula H. & J. iii, 69.
E. sculptilis Pse. iii, 70.
fratercula Pse.
E. subcavernula Tryon, iii, 70.
cavernula Garr. not H. & J.
E. tumuloides Garr. iii, 70.
E. jacquinoti Pfr. iii, 71.
excavata H. & J.
E. coarctata Pfr. iii, 71.
turricula H. & J.
streptaxon Rv.
E. bursatella Gld. iii, 71.
E. retunsa Pse. iii, 71.
E. heynemanni Pfr. iii, 72.
E. gregaria Garr. iii, 72.
E. recedens Garr. iii, 72.

Subgenus ENDODONTA Albers.

Shell more or less depressed, varying from rounded to acutely keeled at the periphery, umbilicus generally open, rarely minute or closed, and never contracted at its opening. *Aperture armed within with teeth or entering plates* (rarely absent by degeneration).

This group comprises a great number of species, and is especially characteristic of the Polynesian fauna, although a few forms are found as far to the west as New Zealand, New Caledonia and the Philippine Islands. The species are unequally related, as is usually the case in large groups; and several minor divisions (*Thaumato-*

don, Ptychodon, Helenoconcha) have received names. These divisions or "sections" are of doubtful value, as they are practically undiagnosable; but still they are natural groups of species, and as such have their uses.

Sections of Endodonta.

a. St. Helena forms — *Helenoconcha.*
aa. Australo-Polynesian forms
b. Shell acutely keeled; teeth generally large, rarely wanting — *Endodonta s. s.*
bb. Shell rounded at periphery
c. parietal wall with one or many liræ, outer lip toothless — *Nesophila.*
cc. outer lip toothed or lirate; parietal wall generally toothed — *Ptychodon, Thaumatodon.*

Section *Endodonta* s. str.

Shell openly or widely umbilicated, depressed, carinated, opaque; aperture obstructed by internal lamellæ, of which there are one or two on the parietal wall and several on the basal wall (but in *E. fabrefacta* lamellæ are absent). Type *E. lamellosa* Fér., pl. 4, figs. 40, 41. (see also *E. obolus* Gld., pl. 4, fig. 39; and *E. fabrefacta* Pse., pl. 5, figs. 52, 53).

Radula having 12–6–1–6–12 teeth. Centrals square, tricuspid; laterals of the same size as the centrals, bicuspid, the entocone being absent. Marginal teeth having a long bifid inner cusp and a short bifid ectocone (Pl. 9, fig. 22, *E. huaheinensis* Pfr.).

Sandwich Island species.

E. apiculata Anc. viii, 95.
E. binaria Pfr. iii, 61.
E. fricki Pfr. iii, 67.
E. lamellosa Fér. iii, 67.
E. laminata Pse.
E. rugata Pse. iii, 67.

Society Island species.

E. cretacea Grt. iii, 66.
E. fabrefacta Pse. iii, 45.
conicava Mouss., Schm.
v. picea Grt.
E. ficta Pse. iii, 62.
E. garrettii Anc. viii, 95.
E. obolus Gld. iii, 61.
acetabulum Pse.
celsa Pse.
barffi Grt.
intermixta Mouss.

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E. huaheinensis Pfr. iii, 61.
aranea Behn.
E. taneæ Grt. iii, 62.
janeæ Schm. & Pfr.
boraborensis Pse. ms.

Pelew Island species.

E. constricta Semp. iii, 67.
E. fuscozonata Bedd. viii, 83.
E. irregularis Semp. iii, 67.
E. kororensis Bedd. viii, 84.
E. lacerata Semp. iii, 67.

Section *Thaumatodon* Pilsbry, 1893.

Pitys Pease, P. Z. S., 1871, p. 450 (in part).—Garrett, Journ. Acad. Nat. Sci. Phila. viii, p. 388 (1881). Not *Pitys* Beck, Index Molluscorum p. 9 (1837).

Shell discoidal, the spire low, convex; umbilicus open or closed; periphery generally broadly rounded; surface rib-striate, unicolored or flammulate. *Aperture having internal teeth or folds upon the outer wall, and the parietal wall, sometimes lacking upon the latter.* (Pl. 4, figs. 35, 36, 37, 38, *E. multilamellata* Grt. See also pl. 4, figs. 33, 34, *E. derbesiana* Cr.).

In *E. multilamellata* Grt. the lamellæ within the outer lip exhibit a peculiar structure; at frequent intervals they bear long curved hook-like processes, directed toward the aperture as shown in pl. 4, fig. 38. This structure is well adapted to prevent the entrance of insect enemies of the snail. No similar formation has been described in other land snails, except in the genus *Strobilops;* but in that group the processes are upon the parietal lamellæ only, while in *Thaumatodon* the palatal lamellæ alone are armed.

Polynesian species.

E. acuticosta Mouss. iii, 60.
E. analogica Pse. iii, 63.
E. anceyana Grt. viii, 96.
E. baldwini Anc.
v. *albina* Anc.
E. boraborensis Grt. iii, 66.
E. consimilis Pse. iii, 60.
societatus Mouss., Schm.
E. consobrina Grt. iii, 66.
E. contorta Fér. iii, 63.
intercarinata Migh.
E. decemplicata Mouss. iii, 63.
E. marquesana Grt. viii, 96.
E. maupiensis Grt. iii, 65.
maupitiensis Pfr.
E. multilamellata Grt. iii, 63.
E. octolamellata Grt. viii, 95.
E. opanica Ant. iii, 67.
oparica auct. iii, 67.
E. parvidens Pse. iii, 64.
incerta Mouss., Pfr.
E. paucicostata Pse. iii, 60.
E. punctiperforata Grt. iii, 66.
E. radiella Pfr. iii, 38.

E. decussatula Pse. iii, 60.
E. dædalea Gld. iii, 64.
E. degagei Grt. iii, 65.
E. distans Pse. iii, 60.
E. elisæ Anc. viii, 95.
E. filocostata Pse. iii, 60.
E. graffei Mouss. iii, 65.
E. hamyana Anc., viii, 95.
E. hystricelloides Mouss. iii, 65.
E. hystrix Migh. iii, 59.
setigera Gld. ms.
E. imperforata Pse. iii, 68.
aitutakiana Mouss., Schmeltz.
E. jugosa Migh. iii, 59.
E. lamellicosta Grt.
pardalina Dh.
undulata Fér.
E. raratongensis Pse. iii, 64.
E. rotellina Pse. iii, 60.
E. rubiginosa Gld. iii, 59.
E. rurutuensis Grt. iii, 61.
E. sexlamellata Pfr. iii, 63.
E. stellula Gld. iii, 61.
E. subdædalea Mouss. iii, 64.
E. subtilis Grt. iii, 66.
E. tiara Migh. iii, 38.
E. unilamellata Grt. iii, 60.
E. verecunda Pse. iii, 63.
E. woapoensis Grt. viii, 95.
E. zebrina Grt. iii, 64.

Species of New Zealand, New Caledonia, Tasmania and Philippine Islands.

E. berlieri Cr. iii, 59.
E. cryptobidens Sut. viii, 85.
E. derbesiana Cr. iii, 63.
E. dispar Braz. iii, 59.
E. jessica Hutt. viii, 85.
E. philippinensis Semp. viii, 82.
E. timandra Hutt. viii, 84.
E. varicosa Pfr. iii, 23.
E. vincentina Cr. iii, 59.

Section *Nesophila* Pilsbry, 1893.

Shell discoidal with open umbilicus, rounded periphery and depressed spire; surface generally ribbed, unicolored or flammulate. Aperture round-lunar, *the parietal wall sculptured with one or many spiral entering liræ; outer wall toothless.* Type *H. tiara* Migh., pl. 6, fig. 66.

The species are Polynesian in distribution. See list under *Thaumatodon*, in which they are included.

Section *Ptychodon* Ancey, 1889.

Ptychodon Anc., Bull. Soc. Mal. Fr. v. p. 372.—Hedley & Suter, Proc. Linn. Soc. N. S. Wales (2) vii, p. 652.—*Maoriana* Suter, Trans. N. Z. Inst. xxiii, p. 96.—Pilsbry, Manual, viii, p. 87.—*Strobila* Hutton, *olim*, not of Morse.—*Huttonella* Suter, Tr. N. Z. Inst. 1890, not of Pfr., 1855.

Shell umbilicated, discoidal, with low-convex spire, rounded periphery and rib-striated surface. Aperture crescentic, subvertical; outer lip thin, simple, armed a short distance within with numerous low folds; columellar lip bearing one or two larger entering lamellæ, and parietal wall bearing one or two stout entering plates, sometimes emarginate, or several smaller folds. Type *E. leioda* Hutton. (Pl. 4, figs. 30, 31, 32, *E. aorangi* Sut.).

Jaw membranaceous, slightly arcuate, with distant vertical striæ (pl. 8, fig. 6, *E. microundulata*).

Radula consisting of 90–100 slightly sinuous transverse rows of teeth, the formula varying from 6–4–1–4–6 (*wairarapa*) to 10–7–1–7–10 (*aorangi*). Central tooth tricuspid. Lateral teeth similar, tricuspid. Marginal teeth tricuspid or quadricuspid, the cusps showing a tendency to coalesce on the outer ones (Pl. 8, fig. 5, *E. microundulata*).

This group is closely allied to the Polynesian section *Thaumatodon*. The species live under bark and rotten wood, in the bush. Our knowledge of them is due to Professor F. W. Hutton and Mr. H. Suter.

E. leioda Hutt. viii, 87.
E. pseudoleioda Sut. viii, 88.
E. wairarapa Sut. viii, 88.
E. microundulata Sut. viii, 89.
E. hectori Sut. viii, 89.
magdalenæ Anc.
E. aorangi Sut. viii, 90.
E. hunuaensis Sut.

Section *Helenoconcha* Pilsbry, 1892.

Manual of Conch. (2), viii, p. 91.

Shell discoidal, umbilicated; aperture armed within with small folds. Type *H. polyodon* Sowb., pl. 4, figs. 42, 43. Distribution, St. Helena.

Soft parts unknown. This group is distinguished from *Thaumatodon* mainly on account of its different distribution. Its generic relationships cannot be affirmed with certainty until the soft parts are examined. It is not improbable that the species of *Patula* described from St. Helena are toothless forms of this group.

E. polyodon Sowb. viii, 93.
alexandri Fbs.
helenensis Pfr.
E. minutissima Sm. viii, 94.
E. leptalea Sm. viii, 95.
E. cutteri Pfr. viii, 93.
E. pseustes Sm. viii, 92.
E. biplicata Sowb. viii, 92.
E. vernoni Sm. viii, 91.
E. bilamellata Sowb. viii, 91.
v. unilamellata Sm. viii, 91.

Subgenus Brazieria Ancey, 1887.

Brazieria Anc., Conch. Exch. ii, p. 22, August, 1887. Not *Brazieria* Petterd, Proc. Roy. Soc. Tasm. for 1888, p. 76 (*Amnicolidæ*).

Shell depressed, narrowly but openly umbilicated, ribbed above, smooth and *shining beneath.* Whorls 4½–5, *the earlier* 1½ *reticulated* (fig. 51), the last strongly keeled. Aperture securiform, *lacking internal lamellæ.* Peristome thickened within, obtuse, *the parietal callus elevated into an erect tongue-like transverse process.* Type *H. velata* Hombr. & Jacq., pl. 5, figs. 49, 50, 51.

Soft parts unknown. The specimens before me were collected by Mr. John Brazier at Lugunar, one of the Caroline Islands. He found it also at Hagolu, Carolines, whence Hombron and Jacquinot procured it. We cannot regard the generic relationships of this snail as established until the soft parts are investigated; it may prove to belong to *Zonitidæ.* The elevated parietal tooth is formed on the plan of that of *Polygyra cereolus,* etc.

E. velata H. & J. iii, 61.

Subgenus Phenacharopa Pilsbry, 1893.

Tesseraria Bttg., in v. Martens' Conchol. Mittheil., i, p. 69 (1881). —Hedley & Suter, Proc. Linn. Soc. N. S. Wales (2), vii, p. 660, 1892. Not *Tesseraria* Hæckel, Das System der Medusen, in Denkschr. Med.-Naturwissensch. Gesellsch. zu Jena i, p. 633 (1879 or 1880).—*Pupa* sp., Pfr., *et al.*

Shell pupiform, cylindrical, the altitude nearly double the diameter; apical end obtusely rounded; base slightly wider, convex, narrowly perforated. Surface ribbed and maculated as in *Charopa s. str.* Aperture subvertical, higher than wide, toothless; peristome simple, thin, the columellar margin dilated. Type *Pupa novoseelandica* Pfr., pl. 6, fig. 60.

Jaw arcuate, ends blunt with distant vertical striæ; upper margin slightly denticulated; a blunt median projection on the cutting edge (pl. 8, fig. 2).

Radula consisting of about 90 straight transverse rows of 11–5–1–5–11 teeth. Central tooth tricuspid. Lateral teeth larger, similar to the centrals, but slightly asymmetrical and with longer mesocones. Marginals broad, the 6th to 12th tricuspid, the mesocone largest; 13th to 15th with four cusps, the ectocone being split, mesocone still longest; last marginal with one broad low cutting point (pl. 8, fig. 1).

To Mr. H. Suter, is due our knowledge of the dentition and jaw of this peculiar shell, as well as the determination of its systematic position. Anatomically it presents no divergence from the typical Charopas, but the elevated pupiform shell resembles *Pupa* far more than *Charopa*.

E. novoseelandica Pfr. ix, pl. 6, f. 60. New Zealand.
Pupa neozelanica auct.

Subgenus ÆSCHRODOMUS Pilsbry, 1892.

Æschrodomus PILS., Nautilus, vi, p. 55, footnote (Sept. 5, 1892), —*Thera* HUTTON, Trans. N. Z. Inst., xvi, p. 193. Not *Thera* Stephens, 1831.

Shell *elevated, dome-shaped*, the altitude about equal to the diameter. Whorls rather narrow, the apical 1½ forming a light colored spirally striated distinct embryonal shell; the lower whorls sculptured with oblique lamellar riblets which bear hairs where they cross the angular periphery; base flattened; umbilicus small but open. Aperture toothless, the peristome thin, simple. Type *E. stipulata* Rv., pl. 6, figs. 67, 68.

Animal (of *E. stipulata*) like that of Charopa coma; mantle subcentral, slightly reflected over the peristome; eye peduncles long and cylindrical; tail short, pointed, and with no mucous gland.

Jaw thin and delicate, but little arched, broadly and faintly vertically striated, sometimes showing a line of reinforcement parallel to the cutting edge (pl. 8, fig. 4, *E. barbatula*).

Radula consisting of about 100 almost straight transverse rows of teeth, the formula varying from 9–3–1–3–9, 10–4–1–4–10 or 10–6–1–6–10 (in *stipulata*) to 15–1–15 (in *barbatula*). Central teeth tricuspid, the mesocone attaining the anterior margin of the basal plate or shorter. Laterals similar but with longer mesocones. Inner marginals tricuspid, the outer quadricuspid by splitting of the ectocone; the outermost having one broad low cusp (pl. 8, fig. 3, *E. barbatula* Rv.

This group differs from typical *Charopa* in its elevated, thimble-like contour, and the peripheral fringe of hairs borne by the riblets. Both of the species are from New Zealand.

E. stipulata Rve. iii, 94.
alpha Pfr.

E. barbatula Rve. iii, 95.
beta Pfr.

Subgenus PARATROCHUS Pilsbry, 1893.

Paratrochus PILS., Manual viii, p. 295.

Shell high-conic, having numerous (8½) whorls; narrowly umbilicated and well sculptured. Aperture nearly round, the peristome continued in a thin callus across the parietal wall. Type *H. dalbertisi* Braz., pl. 6, figs. 55, 56.

Soft parts unknown. The single species is from Yule Island, British New Guinea.

E. dalbertisi Brazier. viii, 295.

Subgenus CHAROPA Albers, 1860.

Shell depressed, umbilicated, discoidal or subdiscoidal. Aperture toothless; lip thin and simple.

This subgenus differs from *Nesophila* in entirely lacking spirally entering liræ upon the parietal wall. It is likely that some of the species included herein have descended from toothed forms; although the toothless Charopas are doubtless nearer than the toothed types to the ancestral form of the genus *Endodonta*.

Sections of Charopa.

a. Shell ribbed or rib-striate, Patuloid; whorls rounded,
Charopa s. s.

aa. Shell often hairy or shaggy; whorls keeled,
Acanthoptyx, Tropidotropis, Pterotropis.

Section *Charopa* Albers, *s. str.*

Charopa ALB., Die Hel. (edit. 2), p. 87, type *H. coma* Gray.—ANCEY, Bull. Soc. Mal. Fr. v, p. 364.—PILSBRY, Manual viii, p. 96.—HEDLEY, Proc Linn. Soc. N. S. Wales (2) vii, p. 157.—*Simplicaria* MOUSS. *MS.*, Suter, Tr. N. Z. Inst. xxiii, p. 90.

Shell depressed, subdiscoidal, the spire varying from convex to concave; openly umbilicated; whorls rather cylindrical, the last rounded or subangular (never keeled) at the periphery. Surface sculptured with oblique or sigmoid rib-striæ; unicolored or painted with radiating reddish flames. Aperture lunate, oblique, the lip thin and simple, more or less sinuous; parietal wall covered by a varnish of callus, the riblets being removed by absorption. Type *E. coma* Gray, pl. 6, figs. 57, 58, 59 (pl. 6, figs. 63, 64, 65, *E. tapirina.*)

Animal small, the mantle rather posterior, tail not produced behind the shell. Eye peduncles large, club-shaped, approximated at their bases; tentacles short. Foot margined by a parapodial groove.

Jaw delicate, thin, more or less arcuate, sculptured with fine spaced subvertical striæ (pl. 9, fig. 24, *E. coma;* pl. 9, fig. 21, *E. sylvia=buccinella.*)

Radula having the teeth in somewhat sinuous transverse rows. Central tooth tricuspid, the mesocone reaching about to the anterior border of the basal-plate, side cusps small. Laterals similar but somewhat asymmetrical, the entocone becoming larger outwardly until it becomes joined at the base with the mesocone. The marginals are very low and wide, by shortening of the basal-plates; tricuspid, the ento- and mesocone often joined at base; ectocone smaller, simple or split into two. Cusps variously degenerate on the outermost marginals (pl. 9, fig. 23, *E. coma*; pl. 9, fig. 20, *E. sylvia=buccinella.*)

In some species, such as *E. dispersa* Gassies, the entocone remains minute upon all of the lateral teeth; and in some the ectocone splits on the marginals; but otherwise the dentition of the species does not differ from that of *E. coma.*

The shell is like *Goniodiscus* in being umbilicated, depressed, rib-striate; whorls tubular, aperture round-lunar or crescentic. It differs from *Goniodiscus* in the tendency of the upper lip to recede toward its insertion, forming a Pleurotomoid sinus or notch between outer lip and body-whorl; and in the more or less depressed (sometimes concave) inner whorls.

The species are very numerous, and they occupy a vast territory; but New Zealand, New Caledonia, and Australia with Tasmania are their especial home.

New Zealand species.

E. anguiculus Rv. iii, 23.
  theta Pfr.
E. bianca Hutt. viii, 97.
  v. montana Sut.
E. biconcava Pfr. i, 130; viii, 104.
E. brouni Sut. viii, 102.
E. buccinella Rv. iii, 23.
  gamma Pfr.
  sylvia Hutt. viii, 98.
E. huttoni Sut. viii, 104.
E. infecta Rv. iii, 23.
  zeta Pfr.
  v. irregularis Sut. viii, 98.
  v. alpestris Sut. viii, 99.
E. lucetta Hutt. iii, 22.
  stokesi Sm. iii, 262.
E. moussoni Sut. viii, 105.
E. mutabilis Sut. viii, 101.

E. caputspinulæ Rv. iii, 102.
epsilon Pfr.
E. colensoi Sut. viii, 99.
E. coma Gray, iii, 22.
v. beta Pfr.
v. globosa Sut. viii, 96.
E. corniculum Rv. iii, 24.
eta Pfr.
v. maculata Sut. viii, 96.
E. egesta Gray, iii, 23.
E. eremita Sut. viii, 103.
E. pseudocoma Sut.
E. raricostata Sut. viii, 100.
E. segregata Sut.
E. serpentinula Sut. viii, 103.
E. sterkiana Sut. viii, 101.
v. major Sut.
v. reeftonensis Sut.
E. subantialba Sut. viii, 104.
E. tapirina Hutt. iii, 23; viii, 97.
E. tau Pfr.
E. variecostata Sut. viii, 100.

New Caledonian species.

E. alveolus Gass.
E. bazini Cr. i, 121.
E. calliope Cr. iii, 36.
E. confinis Gass. iii, 35.
E. costulifera Pfr. i, 120.
v. major Cr.
E. decreta Gass. iii, 26.
E. dispersa Gass. iii, 45.
E. inculta Gass. iii, 26.
E. kanakina Gass. i, 122.
E. koutoumensis Gass.
E. lamberti Cr. iii, 26.
E. melaleucarum Gass. iii, 26.
E. melitæ Gass. iii, 45.
E. morosula Gass.
E. nouméensis Cr.
E. ostiolum Cr.
E. pinicola Pfr. i, 121.
E. rhizophorarum Gass. iii, 36.
E. rusticula Gass. iii, 26.
E. saburra Gass.
E. subcoacta Gass. iii, 26.
E. subtersa Gass. iii, 35.
E. taslei Cr. iii, 36.
E. vetula Gass. iii, 36.

Species of Lord Howe and Norfolk Is.

E. depsta Cox, iii, 46.
E. exagitans Cox, iii, 46.
E. unwini Braz. viii, 106.
E. wilkinsoni Braz. viii, 105.
E. whiteleggei Braz. viii, 106.
v. balli Braz. viii, 107.
v. ledgbirdi Braz. viii, 107.

Species of Australia and Tasmania.

[The following synonymic list was furnished by my valued correspondent and friend, CHARLES HEDLEY, of Sydney, N. S. W.]

E. agnewi Cox, iii, 263.
petterdi Brazier.
var. peroni Brazier.
E. microscopica Cox.
microcosmos Cox.
E. millestriata Smith, i, 130.

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E. albanensis Cox, ii, 209; viii, [pl. 37, f. 43–46.
eastbournensis Beddome & [Petterd.
petterdiana Taylor.
var. stanleyensis Petterd.
var. albida Taylor.
E. antialba Beddome viii, 107.
E. barrenensis Petterd.
E. belli Cox, iii, 25.
E. biretracta Mousson, ii, 208.
E. bischoffensis Beddome, viii, [109.
E. brazieri Cox, iii, 24.
E. cochlidium Cox, iii, 25.
E. corticicola Cox.
E. cupera Cox, iii, 24.
nupera Brazier.
E. curacoæ Brazier.
ramsgatensis Cox, iii, 265.
E. cygnea Benson, ii, 213.
E. diemenensis Cox, iii, 24.
thomsoni Cox.
daveyensis Cox, iii, 265.
atkinsoni Cox, iii, 266.
camillæ Cox.
wellingtonensis Cox.
midsoni Brazier.
E. funerea Cox, ii, 209.
E. furneauxensis Petterd.
E. gadensis Beddome viii, 109.
E. halli Cox.
E. hookeriana Johnston.
E. iuloidea Forbes ii, 209.
omicron Pfeiffer.
ammonitoides Reeve.
legrandi Cox, ii, 209.
ricei Brazier.
onslowi Brazier.
E. kershawi Petterd.
E. mimosa Petterd.
E. mucoides Tenison-Woods. iii, 44.
E. murphyi Cox, iii, 46.
E. murrayana Pfeiffer.
E. nautiloides Cox.
inusta Cox, ii, 209.
E. neglecta Brazier.
luckmani Brazier.
var. siliens Cox.
var. jungermaniæ Petterd.
var. trucanini Petterd.
E. officieri Cox, iii, 266.
E. otwayensis Petterd.
var. alpina Johnston.
E. paradoxa Cox.
morti Cox, iii, 34.
hobarti Cox, iii, 34.
arenicola Tate, iii, 52.
E. pexa Cox, iii, 25.
E. retepora Cox, iii, 34.
E. reteporoides Tate, viii, 110.
E. roblini Petterd.
E. rotella Brazier.
E. saturni Cox, iii, 24.
E. sericatula Pfeiffer, ii, 208.
melbournensis Cox, iii, 35.
E. spaldingi Brazier.
var. carinata Brazier.
E. parvissima Cox.
E. spiceri Petterd.
E. spectra Cox, iii, 266.
architectonica Brazier.
gunni Brazier.
assimilis Brazier.
E. similis Cox.
stellata Brazier, iii, 34.
derelicta Cox.
E. stroudensis Cox, iii, 25.
E. subdepressa Brazier.
dandenongensis Petterd.

E. limula Cox.
E. lottah Petterd.
E. macdonaldi Cox.
kingstonensis Cox, iii, 266.
gouldi Cox.
juliformis Cox, iii, 263.
E. marchianæ Cox.
fuscoradiata Cox, iii, 265.
E. mathinæ Petterd.
E. sublesta Benson.
E. subrugosa Brazier.
E. tamarensis Petterd.
E. tasmaniæ Cox, iii, 34.
E. vigens Cox, iii, 263.
ammonitoides Brazier.
bassi Brazier.
E. vinitincta Cox, i, 115.

* * *

E. lizardensis Pfr. iii, 86.

New Guinea, Aru and Tenimber Is. species.

E. brunnescens Mlldff. viii, 82.
E. demani Tap.-Can. iii, 26.
E. texta Hedley. viii, 294.

Polynesian species.

E. adposita Mouss. iii, 41.
E. canalis Grt. iii, 39.
E. complementaria Mouss. iii, 40.
E. decorticata Grt. iii, 40.
v. otareæ Grt.
E. filiola Fér. iii, 38.
E. glissoni Anc. viii, 82.
E. harveyensis Grt. iii, 40.
E. helva Cox, iii, 262.
E. ignava Pfr. iii, 36.
E. inermis Mouss. iii, 41.
E. lamellicostata Grt. iii, 39.
E. modicella Fér. iii, 38.
v. atiensis Pse.
vicaria Mouss.
v. vicinalis Mouss. iii, 39.
E. monstrosa Anc. viii, 82.
irregularis Mouss. not Semp.
E. oualanensis Pse. iii, 41.
E. planospira Grt. iii, 41.
E. princei Liard. iii, 27.
E. proxima Grt. iii, 39.
E. radicalis Mouss.
E. rotula Hombr. iii, 67.
E. rudis Grt. iii, 39.
? sublaminata Mss, Schm.
E. tenuicostata Grt. iii, 39.
E. youngi Grt. iii, 40.

Section *Acanthoptyx* Ancey, 1888.

Acanthoptyx Ancey, Bull. Soc. Mal. France, v, p. 370.

Shell *discoidal, thin*, openly umbilicated; *whorls few* (3–4) and rapidly increasing, sculptured with fine close lamellar striæ and unevenly spaced *elevated ribs*, rising into lamellæ as they cross the

subangular periphery. *Aperture large, oblique, toothless;* peristome fragile. Type *H. acanthinula* Crosse, pl. 6, figs. 71, 72, 73.

Jaw and soft parts not examined.

Dentition: centrals as wide as long, tricuspid, the mesocone attaining the anterior border of the basal-plate, side cusps small. Laterals similar. Marginal teeth low, wide, with the entocone and mesocone long, united at base, the ectocone split into three minute cusps (pl. 9, fig. 25, *E. acanthinula.*)

E. acanthinula Crosse. iii, 124. New Caledonia.

Section *Tropidotropis* Ancey.

Tropidotropis Anc., Bull. Soc. Mal. Fr. v, p. 370.

Shell broadly umbilicated, discoidal, the spire nearly flat; whorls flat above, the last acutely carinated; epidermis laciniate-lamellose. Aperture securiform, toothless, the peristome simple, acute. Type *H. trichocoma* Crosse, pl. 6, figs. 61, 62.

E. trichocoma Cr. iii, 45. New Caledonia.

Section *Pterodiscus* Pilsbry, 1893.

Tropidoptera Anc., Bull. Soc. Mal. Fr. vi, p. 191. Not *Tropidopterus* Blanch. 1845 (*Coleoptera.*)

Shell umbilicated, depressed, thin or fragile, horny brown. Whorls finely, densely striated, the last acutely keeled at the periphery, carinated around the umbilicus. Aperture oblique, toothless; lip thin and simple. Type *H. alata* Pfr., pl. 4, fig. 44.

Shells of this section have the appearance of the New Caledonian groups *Acanthoptyx* and *Tropidotropis.* The species are from the Sandwich Is.

E. alata Pfr.
E. depressiformis Pse.
E. prostrata Pse.
E. digonophora Anc.

Genus PHASIS Albers, 1850.

Phasis Alb., Die Hel., p. 92. Type and only species *H. menkeana* Pfr.—Pilsbry, Manual viii, p. 135.

Shell resembling *Xerophila;* depressed, umbilicated, *solid, white and opaque,* generally with brown bands or dots, *the apex dark*; last whorl not descending; aperture rounded-lunate, but little oblique;

lip thin, simple, *its columellar margin dilated.* Type *H. menkeana* Pfr., pl. 10, figs. 1, 2, 3.

Distribution, South Africa.

Under this genus as subgenera may be ranged two groups: *Trachycystis* and *Sculptaria*, both belonging to the S. African fauna. The anatomy of typical *Phasis* is unknown. That of *Trachycystis* is described below. The diagnosis given above applies to the restricted subgenus *Phasis* only, to which the following species belong:

P. capensis Pfr. iii, 103.
irrorata Zieg.
littoricola Bens.
P. menkeana Pfr. iii, 108.
P. namaquana Mts. viii, 297.
P. paludicola Bens. iii, 104.
P. sturmiana Pfr. vi, 317.
P. uitenhagensis Kr. iii, 104.

Subgenus Trachycystis Pilsbry, 1892.

Trachycystis Pils., Man. of Conch. viii, p. 136.—*Pella* Alb. (in part), Die Hel. (2), p. 84, 1860. Not *Pella* Steph. 1832.

Shell small, *thin*, generally somewhat translucent, horny or earthy brown in color, usually sculptured with oblique riblets or rib-striæ, the apical whorl spirally striated (fig. 7); aperture lunate; lip simple, thin, *dilated at the columellar insertion.* Type *P. bisculpta* Bens., pl. 10, figs. 5, 6, 7; see also *P. browningi* Bens. pl. 10, figs. 8, 9.

Animal (of *P. rariplicata*) having a rather long slender foot, the sole apparently undivided; foot-margins wide, not crenulated nor more coarsely granulated than the rest of the surface, defined by a pair of shallow grooves; tail lacking a mucous pore.

Jaw thin, having numerous flat plaits.

Radula having the transverse rows of teeth crowded, so that the cusps of one row project over the bases of the next. Central teeth tricuspid, the mesocone longer than the basal plate, slender, side cusps small. Lateral teeth altogether similar, but slightly asymmetrical, the entocones increasing in length outwardly. Transition from lateral to marginal teeth very gradual, the latter tricuspid, the ento- and mesocones subequal, long, oblique and united at their bases, the ectocone smaller, simple (in *P. bisculpta*) or bifid (*P. rariplicata*). Pl. 15, figs. 3, 4, *P. bisculpta.*

All of the teeth are tricuspid; the central and inner lateral teeth are so similar that it is difficult to distinguish which is the rhachidian row, and the mesocones are long and slender. The inner marginal teeth are remarkable for their long ento- and mesocones.

Binney has figured the teeth of *P. rariplicata*, but judging by the radula before me he makes the median teeth too short for their length. He correctly figures the ectocone of the outer marginals as bifid. The radula of *P. bisculpta* has not before been examined.

These shells are shaped like *Phasis* from which they differ in the thin texture and sculpture. Some species resemble the New Zealand group *Allodiscus* and others are like *Thysanophora* or *Patula*. All of them belong to the South African fauna, with the exception of a few species from Mauritius and adjacent islands, which present the same shell characters, but have hitherto been grouped in *Patula* or *Charopa*. The affinities of the genus are with the Charopoid Endodontas as far as present knowledge enables us to judge; and they are separated from that type mainly by their distribution and certain features of the teeth described above. The differences in the radula are, however, of but little importance.

P. actinotricha Melv. & Pons. [viii, 143.
P. ænea Kr. iii, 105.
P. aprica Kr. iii, 107.
P. arachne Morel.
P. aulacophora Anc. viii, 138.
P. bathycœle Melv. & Pons. viii, 139.
P. bisculpta Bens. iii, 105.
P. browningii Bens. viii, 136.
P. burnupi Melv. & Pons. viii, [140.
P. caldwelli (Barcl.) Bens. iii, 27.
paulus Mor.
P. conisalea Melv. & Pons. viii, [145.
P. crawfordi Melv. & Pons. viii, [146.
P. epetrima Melv. & Pons. viii, [146.
P. erateina Melv. & Pons. viii, [137.
P. farquhari Melv. & Pons. viii, [147.
P. glanvilliana Anc. viii, 147.
P. microscopica Kr. iii, 106.
P. minythodes Melv. & Pons. [viii, 144.
P. newtoni Nev. iii, 27.
P. perplicata Bens. iii, 106.
P. petrobia Bens. iii, 107.
P. planti Pfr. viii, 142.
platti Pfr. *olim.*
v. africæ Brn. viii, 142.
P. prionacis Bens. viii, 137.
P. rariplicata Bens. iii, 107.
P. rhysodes Melv. & Pons. viii, [141.
P. rivularis Kr. iii, 107.
P. rodriguezensis Cr.
P. sabuletorum Bens. iii, 107.
P. somersetensis Melv. & Pons. [viii, 295.
P. strobilodes Melv. & Pons. [viii, 147.
P. tabulæ Chap. viii, 139.
P. trichosteiroma Melv. & Pons. [viii, 143.
P. tuguriolum Melv. & Pons. [viii, 145.

P. hottentota Melv. & Pons. [viii, 141.
P. inops Morel. viii, 144.
P. liricostata Melv. & Pons. [viii, 140.
P. loveni Kr. iii, 106.
P. lygæa Melv. & Pons. viii, [138.
P. turmalis Morel. viii, 144.
P. viridescens Melv. & Pons. [viii, 78.
P. vorticialis Bens. iii, 107.
P. vorticella H. Ad. iii, 35.
P. zanguebarica Craven.

Subgenus ? SCULPTARIA Pfr., 1856.

Sculptaria PFR., Malak. Blätter ii, p. 135, type *H. sculpturata* Gray.

Shell small, discoidal, carinated, widely umbilicated; last whorl becoming free at the aperture; aperture very oblique, rounded, with continuous slightly expanded peristome, and having several teeth on the outer lip and an entering parietal lamina. Type *H. sculpturata* Gray, pl. 10, fig. 4.

Anatomy unknown. A group of problematic relationships, represented by a few species in southwestern Africa (Damaraland).

S. damarensis H. Ad. iii, 138.
S. sculpturata Gray, iii, 138.
v. collaris Pfr. iii, 138.
S. chapmanni Anc. viii, 152.
S. retisculpta Mts. viii, 152.

Genus AMPHIDOXA Albers, 1850.

Amphidoxa ALB., Die Hel. p. 110 (for *H. marmorella* and *helicophantoides*); Edit. Martens, p. 82.

Shell thin, depressed-globose or discoidal, perforated or umbilicated; aperture lunar-rounded or ovate; peristome simple, thin. Type *H. marmorella* Pfr., pl. 7, figs. 10, 11, 12.

Distribution: southwestern shore of South America and adjacent islands, Juan Fernandez, Chiloe, etc., Cape Horn region and Kerguelen Is.

These shells resemble some forms of the genera *Flammulina* and *Endodonta*; the typical Amphidoxas recalling *Flammulina* or *Calymna*, the Stephanodas being like *Allodiscus*, *Suteria* or *Charopa*. The anatomy of the South American forms is unknown, but that of *A. hookeri* of Kerguelen Island shows an affinity to *Charopa* in the possession of parapodial grooves. Two sections compose this group.

Section AMPHIDOXA Alb.

Shell small, perforate, depressed-globose, thin and pellucid, costulate-striate, Whorls 3–3½, rapidly enlarging. Aperture ample. Anatomy unknown. Distribution, Juan Fernandez.

A. marmorella Pfr. iii, 46. A. helicophantoides Pfr. iii, 46.

Section STEPHANODA Albers, 1860.

Stephanoda ALB., Die Hel. (2) p. 88. Type *H. dissimilis* Orb. *Stepsanoda* PFR., Nomencl., p. 93.

Shell umbilicated, thin, costulate, sometimes spirally striated; in shape like Discus or Charopa. Whorls 5–7, the last cylindrical, not descending. Aperture rounded lunar; lip thin, simple. Type *H. dissimilis* Orb., pl. 7, figs. 19, 20, 21. See also pl. 7, figs. 16, 17, 18, *A. hookeri* Reeve.)

Anatomy of the typical forms unknown; of *A. hookeri* as follows, the living animal according to Eaton's observations (Philos. Trans., 1879, p. 183), the internal anatomy according to Schako and Pfeffer (Monatsber. K.-P. Akad. Wissensch. Berlin, 1877, p. 269.)

Animal (in spirit) with a narrow foot, rather narrower posteriorly than in front. The sole of a pale livid olive, sides dark slate color. Mantle above the head pale livid, dotted with dark slate spots. During life the animal (viewed through a lens), is black, reticulated with gray; tentacles either black above and dark gray beneath longitudinally, or dark gray throughout. Foot bordered above by a ribbon-like stripe which is composed of long oblong tessellations whose interstices are gray, which is separated by a thin pale irregular line from the more finely reticulated upper portion of the sides and back. The interspaces of the reticulation of these last are slightly raised and black, and cause the surface to be somewhat granulated. Some of the lines of growth of the shell are occasionally straw color (*Eaton*). Sole tripartite, divided into areas by two longitudinal and many transverse grooves, the outer areas darkly pigmented. No appendages upon the mantle margin.

Genitalia simple, without accessory organs; vas deferens inserted at the apex of penis, passing gradually into it; spermatheca terminating in a short straight or bent appendage, and situated upon a rather long duct (pl. 1, fig. 16, *A. hookeri.*)

Jaw measuring ·7 x ·68 mill., rather narrow, low-arcuate, sculptured with fine, somewhat wavy transverse striæ and numerous nar-

row vertical grooves, which hardly crenulate the cutting edge. In young examples it seems as if composed of narrow plates held together by the underlying membrane (*Schako*). Pl. 1, fig. 15, *A. hookeri*.

Radula measuring 2·41 x ·68 mill., consisting of 205 closely placed transverse rows, each with 35, 51, 57 or 65 teeth. Formula 25–11–1–11–25. Rhachidian tooth with a broad, blunt, rounded mesocone, no side cusps. Laterals similar, the cusp often extending beyond the thin basal-plate. Marginals tricuspid, the side cusps small but distinct, obsolete on the outer marginals (pl. 1, fig. 14, *A. hookeri*, showing teeth R, 1, 12, 17, 22, 25.)

The principal peculiarity of the radula is that the central and lateral teeth possess mesocones only, in this respect differing from the genera *Endodonta* and *Phasis;* but as the dentition of but one species is known, too much stress should not be laid upon this feature. The close alliance of the toothless Endodontas (*Charopa*), the S. African group *Trachycystis*, the northern genus *Pyramidula*, and the S. American *Amphidoxa-Stephanoda* series, is evident.

A. arctispira Pfr. iii, 47.
A. binneyana Pfr. iii, 48.
A. bryophila Ph. iii, 42.
A. ceroides Pfr. iii, 47.
A. chilensis Mühlf. iii, 42.
A. coiquecana Ph. iii, 43.
A. coppingeri Sm. iii, 42.
A. corticaria Ph. iii, 43.
A. costellata Orb. iii, 41.
A. dissimilis Orb. iii, 48.
histrio Mühlf.
plagiata Beck.
A. epidermia Ant. iii, 42.
A. exigua Ph. iii, 43.
A. germaini Ph. iii, 43.
A. gratioleti Hupé, iii, 48.
A. holmbergi Dör. iii, 43.
A. hookeri Rve. iii, 48.
A. hypophlœa Ph. iii, 43.
A. jungermanniarum Ph. iii, 43.
A. leptotera Mab. & Roch. viii, 81.
A. lirata Couth. iii, 42.
A. magellanica Sm. iii, 42.
A. musicola Ph. iii, 43.
A. ordinaria Sm.
A. pazii Ph. iii, 43.
minviellei Ph.
A. pleurophora Moric. iii, 53.
A. pusio King, iii, 47.
A. quadrata Fér. iii, 47.
kingi Pfr.
A. rigophila Mab. & Roch. viii, [81.
A. selkirki Sm. iii, 47.
A. spirillus Gld.
A. stelzneriana Ph. iii. 43.
A. strobeliana Ph. iii, 43.
A. tenuistriata Ph. iii, 48.
A. tessellata Mühlf. iii, 47.
contortula Fér.
A. zebrina Ph. iii, 48.

Genus PYRAMIDULA Fitzinger, 1833.

Pyramidula Fitz., Systematisches Verzeichniss der im Erzherzogthume Oesterreich vorkommenden Weichthiere, als Prodrom einer Fauna derselben, p. 95 (for *H. rupestris* Drap.)

\+ *Gonyodiscus* and *Discus* Fitz., 1833; *Patula* Held., 1837; *Delomphalus* Ag., 1837; *Eyryomphala* Beck, 1837; etc., etc.

=*Patula* of most modern authors.

Shell openly umbilicated, varying in contour from flattened and disk-like to conoidal. Generally opaque, often rib-striate. Unicolored, spirally banded or flammulate. Whorls subcylindrical or keeled, the apex generally smooth. Aperture rounded-lunate; lip simple and thin. Type *P. rupestris* Drap.

Animal having *the sole undivided; lateral margin of the foot with a distinct border bounded by a groove,* the grooves meeting above the tail. No caudal mucous pore. Eye-peduncles long and slender (pl. 14, fig. 40, 46, *P. alternata.*)

Genital system lacking all accessory organs; vas deferens and retractor muscle inserted near or at the apex of the penis; duct of the spermatheca very long; hermaphrodite duct very long, but shortened by its extreme convolution (pl. 11.)

Jaw arcuate, its component laminæ generally compactly soldered, and indicated only by fine striæ which diverge slightly from the middle.

Radula (1) having only the mesocones developed upon central and inner lateral teeth, or (2) having the centrals tricuspid, laterals bicuspid lacking the entocones, marginal teeth similar but with short basal-plates; this being the usual form. In some species the marginal teeth are multicuspid by the splitting of their ectocones.

The dentition, as usual, shows considerable variation, even in species otherwise closely related. As a general rule, the lateral teeth completely lack entocones, differing in this respect from *Trachycystis* and the *Endodonta-Charopa* series; but in the section *Helicodiscus,* entocones are well developed. The dentition is quite unlike *Trachycystis* in the forms of the marginal teeth.

The genus *Pyramidula* consists of dull-colored ground-living snails, species of which occur over the whole northern temperate land area. Its nearest relatives are *Charopa, Trachycystis* and *Stephanoda,* genera occupying the southern temperate regions of Australasia, Africa and South America respectively. All may be regarded as the remnants of an early fauna, now replaced in the tropics, and to a large extent

in temperate regions also, by higher groups of Helices. The latter differ widely from these Patuloid genera in lacking parapodial grooves, in the solid, ribbed jaw, complex genital system, and other features to be described later.

In treating of the subgenus *Patula* it will be shown that that name is not available as a designation for the present genus as a whole. *Pyramidula* is the earliest name, and should be accepted. It may be objected that no diagnosis of *Pyramidula* was published by Fitzinger, but the same may be said of Beck's genera. Let those who repudiate Beck's names cast the first stone at Fitzinger!

Pyramidula is divisible into eight subordinate groups, which may be tabulated thus:

a. Shell lacking internal teeth or folds,
  b. Spire conical; size very small, shell thin, *Pyramidula s. s.*
  bb. Spire depressed,
    c. Shell rather large and solid, *Patula.*
    cc. Shell small or minute,
      d. Surface spirally lamellate, *Lyrodiscus.*
      dd. Body-whorl with 20–25 spaced oblique laminæ, *Planogyra.*
      ddd. Surface striate or rib-striate, *Gonyodiscus, Patulastra.*
aa. Body-whorl having one or several pairs of internal teeth,
  b. Internal teeth tubercular; surface spirally sculptured, *Helicodiscus.*
  bb. Internal teeth lamellar; surface obliquely sculptured, *Atlantica.*

Besides these, another group, *Pupisoma*, has been referred provisionally to this genus.

Subgenus Pyramidula Fitz.

Shell small, moderately or widely umbilicated, lacking internal folds or teeth.

The following sections may be grouped under this subgeneric head: *Pyramidula s. str.*, *Patulastra*, *Planogyra*, *Gonyodiscus* and *Lyrodiscus.*

Section *Pyramidula* Fitz., *s. str.*

Pyramidula Fitz., Syst. Verz., p. 95.

Shell minute, openly umbilicated, with pyramidal spire and obtuse

smooth apex. Whorls tubular, obliquely striated. Aperture round or nearly so; lip simple. Type *H. rupestris* Dr., pl. 10, figs. 15, 16.

Jaw arcuate, finely striated vertically.

Radula having the central teeth unicuspid, the side cusps being represented by a slight sinuation. Laterals bicuspid. Marginals with low wide basal-plate, the inner bearing two cusps, the outer becoming multicuspid by splitting of the cusps, (pl. 11, fig. 25, *P. rupestris* Dr.)

Distribution, Europe and Central Asia.

This section differs from *Gonyodiscus* and *Patulastra* in having the spire conically elevated, and from the former in lacking rib-striæ.

P. rupestris Dr. iii, 51.
umbilicata Mont.
aliena Zieg.
spirula Villa.
myrmecidis Scac.
f. rupicola Stab.
f. saxatilis Hm.
f. subglobosa Bgt.
f. conoidea Bgt.
f. meridionalis Iss.
f. jænensis Cl. iii, 51.
f. dalmatina Cl.
f. pinii Ad. iii, 51.
P. chorismenostoma Bl. & West.
P. hierosolymitana Bgt. iii, 52.
P. humilis Hutt. iii, 22.
P. orphana Hde.
P. euomphalus Blf. iii, 32.
P. abbadiana Bgt. iii, 52.
P. brucei Jick. iii, 52.
P. amblygona Reinh. iii, 52.
P. lepta West. viii, 81.

Section *Patulastra* Pfeiffer, 1878.

Patulastra Pfr., Nomencl. Hel. Viv., p. 87.

Shell having the form of *Patula*, but minute, with fewer whorls, the surface unicolored, with or without riblets.

This section may be retained to include the minute forms similar in general characters of the shell to *Punctum*, but with the anatomical features of the genus *Pyramidula*. The limits of the group are uncertain, as part of the species might be placed in the sections *Gonyodiscus* or *Pyramidula*, and others are likely to prove Punctums. Of course the mélange included here by Pfeiffer and by Tryon must be assorted into many diverse groups.

P. abyssinica Jick. iii, 32.
rivularis Mts.
P. aranea Parr. iii, 31.
P. aucapitainiana Bgt. iii, 29.
P. balatonica Serv. iii, 31.
P. bussacona Silv.
P. debeauxiana Bgt. iii, 28.
P. carotae Bgt. Serv. iii, 31.
P. elachia Bgt. iii, 28.
P. gallæciana Silv.
P. henriquesi Silv.
P. lederi Bttg, iii, 31.

P. luseana Paiv. iii, 31.
P. massoti Bgt. iii, 29.
P. micropleuros Pag. iii, 28.
P. microstigmæa Silv.
P. nemesiana Bgt. iii, 31.
P. pornæ Serv. iii, 31.
P. poupillieri Bgt. iii, 29.
P. pusilla Lwe. iii, 31.
hypocrita Dohrn.
servilis Sh.
P. servaini Bgt. iii, 31.
P. simoniana Bgt. iii, 31.
P. sororcula Ben. iii, 29.
P. tenuicostata Sh. iii, 28.

Section *Planogyra* Morse, 1864.

Planogyra Morse, Obs. Terrest. Pulm. Maine, p. 24, type *P. asteriscus* Mse.

Shell minute, discoidal, openly umbilicated, the spire flat. *Whorls bearing thin, sharp, spaced laminæ*, parallel to growth-striæ. Aperture rounded-lunar, lip simple. Type *P. asteriscus* Morse, pl. 10, figs. 10, 11.

Jaw slightly arcuate, bluntly rounded at the ends, irregularly vertically wrinkled, the concave margin having a slight median projection.

Radula consists of 77 transverse rows containing about 13.1.13 teeth. Centrals tricuspid. Laterals lacking the entocone. Marginal teeth multicuspid, the mesocone largest, bifid (pl. 11, fig. 21, *P. asteriscus* Morse).

The radula differs from that of *Pyramidula s. str.* only in the development of side cusps on the central tooth, and the shorter mesocone of the same. But one species is known; it is widely distributed in Canada and northern New England, living in very wet places.

Morse represents the eye-peduncles of this species as short, thick, and club-shaped (pl. 10, fig. 10); his observation should be checked by an examination of the living animal, as that form of eye stalk is widely different from the other *Pyramidula* species.

Section *Gonyodiscus* Fitzinger, 1833.

Gonyodiscus Fitz. Syst. Verz. p. 98, proposed for *G. perspectivus* Fitz.=*H. solaria* Mke.—*Discus* Fitz., Syst. Verz., p. 99; proposed for *H. rotundata, ruderata, pygmæa, cristallina* (not *Discus* Less. 1837, nor of Hald. 1840, nor of Alb. 1850, nor of Campb. 1879).—*Patula* Held, in part.—*Delomphalus* Agassiz, in Charp., Catal. des Moll. Terrest. et Fluv. de la Suisse, p. 12, in Nouv. Mém. de la Soc. Helvétique des Sci. Nat. i, Neuchatel, 1837; proposed for *H. rotundata, ruderata pygmæa.*—*Eyryomphala* (in part) Beck, Index,

p. 8.—*Patularia* Clessin, Die Molluskenfauna Oesterreich-Ungarns und der Schweiz, p. 104 (proposed for *P. rotundata, hauffeni, ruderata, solaria, pygmæa*).—*Spelæodiscus* Brusina, Mittheil, naturwissensch. Ver. Steiermark, 1885, p. 37, type, *H. hauffeni*. *Allerya* Bourguignat, Atti Ac. Palermo, 1876 (=embryonic shells of *H. rotundata*, etc.).

Shell rather small, depressed, with low but convex spire and open umbilicus. Apical 1½ whorls smooth, the rest obliquely rib-striate, rather tubular, rounded or keeled at the periphery, unicolored or flamed with reddish. Aperture wide-lunate, the lip simple. Type *P. solaria* Mke., pl. 10, fig. 14. See also pl. 10, figs. 12, 13, *P. rotundata* Müll.

Animal (of *P. perspectiva* Say) long and narrow, the foot white, head and back dusky blue. Sole equal in length to the diameter of the shell, undivided (having a central longitudinal sulcus when entering the shell or in alcohol); margins of foot having a wide border, bounded by a distinct groove, the grooves meeting above the tail. Upper surface coarsely granulated. Eye peduncles long and slender, from one-third to one-half as long as the foot (pl. 14, fig. 45).

Genital system lacking all accessory organs. The penis is short, having the retractor and the vas deferens inserted at its apex. Spermatheca small, situated upon a very long simple duct, which enters the vagina very low. At the base of the albumen gland there is a rather large talon. The albumen gland is small and adherent to the lower part of the hermaphrodite duct; the latter being large and very much convoluted (pl. 11, fig. 22, *P. perspectiva*).

The genital system of *P. rotundata* as figured by Lehmann is similar. Leidy's figure of that of *perspectiva* is incorrect in showing an appendicula.

Jaw arcuate, with a slight median projection, finely striated, the striæ subvertical, diverging below toward the outer basal angles of the jaw (pl. 11, fig. 19, *P. perspectiva*). The jaw of *rotundata*, according to Lehmann and Moquin-Tandon, has fewer, more spaced striæ than I have found in *P. perspectiva*. That of *P. balmei* (pl. 15, fig. 2) is very distinctly and closely striated, and differs from the jaw of *perspectiva* is being incompletely soldered, the edges of the component vertical plates being slightly free, as in some charopoid snails.

Radula bearing crowded teeth (in *P. perspectiva*, arranged according to the formula 12.8.1.8.12). Centrals having a long mesocone and small side cusps. Laterals having no entocone, the mesocone oblique, ectocone small. Marginals similar, but with short, broad basal plates (pl. 11, fig. 26, *P. perspectiva*).

In *P. balmei* the marginal teeth are like those of *Planogyra asteriscus*.

This section is distinguished from *Pyramidula s. str.* by its low spire, discoidal form, and the rib-striation, which is often obsolete below the periphery, but generally persists on the upper surface and within the umbilicus. The typical species of *Gonyodiscus* are carinated at the periphery, and those with rounded whorls have been separated under the name *Discus*, but such a separation does violence to the facts in the case, for *all intermediate stages of contour between the most acutely carinated and the rounded types occur*. As well might one separate *Papuina brumeriensis* from *diomedes* as a distinct section, or *Pyramidula* (*Patula*) *cumberlandiana* from *alternata*. Such classification may be left for those who point the small end of the telescope at nature.

Eurasian species.

P. abietana Bgt. iii, 21.
P. aperta Mlldff. viii, 80.
P. assarinensis Calc. iii, 51.
P. balmei P. & M. iii, 30.
flavescens Parr.
flavida Zieg.
striolata Ph.
P. bianconii Dh. iii, 32
P. carpetana Hid.
P. concinna Lwe. iii, 21.
P. costulata Mlldff. iii, 266.
P. engonata Shuttl. iii, 43.
v. pallidior Mouss.
P. erdeli Roth. iii, 30.
P. flocculus Mor.
P. frivaldskyana Rm. iii, 21.
convexa Fér.
P. gortschana Mouss. iii, 20.
P. hauffeni Schm. iii, 30.
P. luseana Paiv. iii, 31.
P. omalisma Bgt.
P. pallens Gred. viii, 82.
P. pauper Gld. iii, 20.
P. putrescens Lwe. iii, 31.
P. retexta Sh. iii, 44.
P. rotundata Müll. iii, 19.
brocchiana Calc., Ben.
cupaniana Calc., Ben.
radiata DaC.
v. pyramidalis Jeffr.
v. globosa Friedl.
v. turtoni Flem. iii, 19.
P. ruderata Stud. iii, 20.
umbilicus Mark.
perspectiva Fér.
v. angulosa Mouss. iii, 26.
v. opulens West. iii, 20.
P. solaria Mke. iii, 43.
perspectiva Mühl.
megerlei Jan.

P. sudensis Pfr. iii, 30.
P. textilis Sh. iii 31.
P. zapateri Hid.

American species.

P. perspectiva Say. iii, 20.
patula Dh.
P. bryanti Harp. iii, 43.
P. horni Gabb. iii, 21.
P. striatella Anth. iii, 20.
v. catskillensis Pils.
v. cronkhitei Newc. iii, 21.

Section *Lyrodiscus* Pilsbry, 1893.

Lyra Mousson, Rev. Faune Malac. Canar., p. 26. Not *Lyra* Cumberl., 1816.

Shell depressed, with large open umbilicus and low-convex spire, in form being like Patula; surface sculptured with slight growth-lines and *numerous elevated cuticular spiral threads.* Type *H. circumsessa* Shuttlew. Anatomy unknown. Distribution, Canary Islands.

P. circumsessa Sh.
P. torrefacta Lwe.

Subgenus Patula Held, 1837.

Patula Held, Isis, 1837, p. 918 (proposed for *alternata, rotundata, solaria, perspectiva, ruderata, pygmæa, rupestris*).—*Eyryomphala* Beck, Index Moll. p. 8 (proposed for *solitaria, alternata, perspectiva, ruderata, solaria, rudis, rotundata, rupestris, pygmæa, pusilla, lineata* and some undescribed *Amphidoxa* or *Stephanoda* species).—*Euryomphala* Herm. *et al.*—*Anguispira* Morse, Obs. Terr. Pulm. Maine, p. 11, type *H. alternata* Say.

Shell rather large and solid, with convex spire and open umbilicus; whorls rounded or carinated at the periphery. Surface striate, ribbed-striate or spirally ribbed, obliquely flamed, unicolored or spirally banded; lip thin, simple. Type *P. alternata* Say, pl. 14, figs. 34, 35, 36.

Animal having a large foot, its length greater than the diameter of the shell, the tail rounded; sole without any traces of longitudinal divisions; the foot-margins having a wide border above, bounded by a distinct groove, the grooves meeting over the tail (fig. 40). Eye-peduncles long and slender, tentacles minute. Mantle edge thick (pl. 14, figs. 40, 46, *P. alternata*).

Genital system simple, lacking accessory organs. Penis receiving the vas deferens and the retractor muscle at its summit. Spermatheca bulbous, its duct very long. Ovi-sperm duct very much convoluted, the ovo-testis consisting of small groups of large club-shaped follicles. Eye-peduncle retracted between the branches of the genitalia (pl. 11, fig. 20, *P. alternata* Say. Pl. 11, fig. 27, *P. strigosa* Gld.)

Jaw strong and opaque, arcuate, with a slight or obvious median projection; surface rather faintly subvertically striated (pl. 11, fig. 18, *P. alternata.* Pl. 11, fig. 17, *P. strigosa*).

Radula: Central teeth having the mesocone long, side cusps small. Laterals having a large mesocone and a well developed ectocone; no entocone. Marginals similar, but with the basal plate short, as usual (pl. 11, fig. 23, *P. alternata*). This type of dentition is common to *P. alternata, solitaria* and *idahoensis.* In *P. cumberlandiana* the side cusps are obsolete on central and inner lateral teeth.

In *P. strigosa* and *haydeni* the central and lateral teeth lack ectocones. The outer marginal teeth have an ectocone developed, and sometimes it is split into two minute cusps (pl. 11, fig. 28, *P, strigosa*).

The Patulas of eastern America are oviparous, the eggs small. round, not hard-shelled. *P. strigosa* and its allies are viviparous, four to six young occupying the uterus at the same time, the most mature having a shell of 2½ whorls, 3 to 4 mill. diameter, the earlier 2 whorls with fine oblique and spiral striæ, marked off by a distinct line from the latter third of a whorl, which is spirally lirate and more or less hirsute. The viviparous mode of reproduction has probably been assumed on account of the aridity of the Rocky Mountain region. The rains are in this area uncertain, and for snails mainly unseasonable; and probably insufficient to insure the development of eggs committed to the earth in the usual way.

Snails of this section are distributed over the whole of the United States except the Californian slope. Individuals of the species are numerous, *P. alternata* in the East and *strigosa* in the West being among the commonest of land snails. They live by preference in rocky places, the talus of a limestone cliff being a favorite station.

The species are polymorphic to a degree inconceivable to those who have not actually seen large series of the shells. *P. alternata fergusoni* and *P. cumberlandiana* seem to be the extremes of one series of forms, and *P. idahoensis* and *haydeni* of another.

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The name *Patula*, as well as *Eyryomphala*, was intended to include all of the forms referred now to the genus *Pyramidula;* and most recent authors have adopted *Patula* as the generic name. Such a course is inadmissible on account of the earlier names *Pyramidula*, *Gonyodiscus* and *Discus* of Fitzinger; and there is, moreover, another difficulty, for *Patula*, *Delomphalus* and *Eyryomphala* were all proposed in the same year (1837), and it is now impossible to decide which should be given priority. In von Martens' edition of Albers, the type of *Patula* is said to be *H. rotundata;* but as that species was already the type of a prior group (*Discus*), we cannot accept such a selection. We are, therefore, obliged to consider Held's first species, *H. alternata*, the type.

Species.

P. alternata Say, iii, 57.
scabra Lam.
strongylodes Pfr.
infecta Parr.
v. fergusoni Bld. iii, 57.
v. mordax Shutt. iii, 57.
P. cumberlandiana Lea, iii, 58.
P. solitaria Say, iii, 58.
kochi Pfr.
subrudis Pfr.
P. idahoensis Newc. iii, 55.
v. newcombi Hemph. viii, 115.
f. wasatchensis Hemph. viii, [116.
v. binneyi Hemph. viii, 116.
f. multicostata Hemph. viii, 116.
f. castanea Hemph. viii, 116.
f. albofasciata Hemph. viii, 116.
f. gouldi Hemph. viii, 116.
P. strigosa Gld. viii, 117.
parma Hemph.
P. strigosa Gld. (Pl. 14, f. 37–39.)
f. depressa Ckll.
f. fragilis Hemph. viii, 117.
f. carnea Hemph. viii, 117.
f. rugosa Hemph. viii, 117.
f. albida Hemph. viii, 117.
f. buttoni Hemph. viii, 117.
f. globulosa Ckll. viii, 118.
v. jugalis Hemph. viii, 117.
v. subcarinata Hemph. viii, 118.
bicolor Hemph. viii, 118.
lactea Hemph. viii, 118.
picta Hemph. viii, 118.
v. cooperi W. G. B. viii, 118.
P. haydeni Gabb. iii, 57.
f. hemphilli Newc. viii. 119.
f. gabbiana Hemph. viii, 119.
f. bruneri Anc. viii, 119.
oquirrhensis Hemph.
hybrida Hemph.

Subgenus ATLANTICA Ancey, 1887.

Atlantica ANC., Conch. Exch. i, p. 54, April, 1887, type *H. semiplicata* Pfr.

Shell small, discoidal, with wide shallow umbilicus and low-convex spire; whorls narrow, obliquely ribbed above, polished below, the

last obstructed far within by several *pairs of elevated lamellæ* upon the basal-outer wall (fig. 32). Lip thin, simple. Type *H. semiplicata* Pfr. pl. 14, fig. 32, 33.

Anatomy unknown. Distribution, Madeira. This group is probably a modification of *Goniodiscus*.

P. semiplicata Pfr. iii, 44. P. calathoides Paiv. iii, 44.
gueriniana Lwe.

Subgenus Helicodiscus Morse, 1864.

Helicodiscus Mse., Obs. Terrest. Pulm. Maine, p. 25, type *H. lineata* Say.

Shell small, disk or coin-shaped, with flat spire and broad, shallow umbilicus. Whorls numerous, convex and closely coiled, spirally striated or lirate, the last whorl having one or several pairs of tubercular teeth within, situated upon the basal-outer wall. Aperture lunate, lip thin, simple. Type *P. lineata* Say, pl. 14, figs. 29, 30, 31.

The shell lies perfectly flat upon the posterior end of the foot, the eye-peduncles standing nearly vertically; posterior end of the long and narrow foot conspicuously furrowed above, very short behind the mantle (pl. 14, figs. 47, 48, *P lineata*).

Jaw arcuate, striate, the striæ diverging somewhat from the median line; median projection inconspicuous (pl. 15, fig. 1, *P. lineata*).

Morse's figure represents the jaw as less arcuate and pointed at the ends. The jaw figured on my plate, however, seems to be perfect, although the ends are blunt.

Radula having about 77 rows of 12·1·12 or 13·1·13 teeth. The central tooth is decidedly narrower than the laterals, its mesocone very short, side cusps minute. Laterals with large square basal-plates, the mesocone as long as the basal-plate, entocone and ectocone equally developed, strong, with short cutting points. Marginals low, wide, the ectocone bifid or trifid (pl. 11, fig. 24, *P. lineata*).

These minute snails live upon decaying wood. The most conspicuous features of the dentition are the tricuspid lateral teeth, recalling those of *Stephanoda* or *Charopa*, and unlike the teeth of *Pyramidula* generally, in which the entocones are as a rule absent. The splitting of the ectocones of the marginal teeth is correllated with the small size of the creature, snails of many groups assuming the Pupa-like form of marginal teeth when the size of the animal becomes minute.

P. lineata Say, ii, 200.
P. fimbriatus Weth. ii, 200.
v. salmonensis Hemph.
salmonaceus Hemph., W. G. B.
v. sonorensis Coop.

Subgenus ? PUPISOMA Stoliczka, 1873.

Pupisoma STOL., Journ. Asiat. Soc. Beng. xlii, p. 32.—PFR.-CLESS, Nomencl. Hel. Viv., p. 352.—v. MOLLENDORFF, Bericht Senck. naturforsch. Ges., 1890, p. 223.

Shell minute, thin, brown, perforated; varying from Pupiform, almost cylindrical, to globose-conoidal; apex obtuse; whorls rounded, with delicate, irregular, cuticular riblets. Aperture oblique, truncate-oval or rounded, the lip thin, simple or a little expanded, broadly dilated at the columella, nearly closing the umbilical perforation; the columellar edge sometimes slightly projecting, but hardly dentate. Type *Pupa lignicola* Stol., pl. 14, figs. 41, 42. See also *P. philippinicum* Mlldff., pl. 14, figs. 43, 44.

Animal having very short eye peduncles and barely a trace of tentacles. (*Stol.*). Jaw, radula and genitalia unknown.

Distribution, India, Borneo, Philippines.

A group of uncertain position. Stoliczka referred it to *Pupidæ;* v. Möllendorff to the *Fruticicola* series, near *Acanthinula* and *Zoogenites.* For the present I prefer to consider it a modification of *Pyramidula*, comparable to the American group *Ptychopatula;* but I am not sure that it is not a group of *Pupidæ.*

P. lignicola Stol.
P. orcella Stol.
P. orcula Bens. ii, 177.
P. pulvisculum Iss. iii, 191.
P. philippinicum Mlldff.
P. miccyla Bens. ii, 176.

Genus PARARHYTIDA Ancey, 1882.

Pararhytida ANC., Le Naturaliste 1882, p. 85; Bull. Soc. Mal. Fr. v, p. 360.—*Platystoma* ANC., 1882, Not *Platystoma* of Klein or Hörnes, nor *Platyostoma* Conr.—*Saissetia* (Bayle) ANC., Bull. Soc. Mal. Fr. v, p. 368, 1888.

Shell perforate or umbilicate, *solid and strong*, depressed, acutely keeled (but periphery rounded in section *Saissetia*). *Baso-columellar lip thickened by a callus within, and dilated at the insertion.* Type *H. dictyodes* Pfr.

Under this generic head may be comprised two groups, as follows:

Section *Pararhytida s. str.*

Shell thick lens-shaped, in form like *Trochomorpha*. Whorls about 6, *slowly increasing, acutely keeled*, basal lip somewhat sinuous. Type *H. dictyodes* Pfr., pl. 7, figs. 25, 26, 27.

External anatomy unknown. Jaw arcuate, quite strong, without median projection, and absolutely smooth (pl. 9, fig. 35, *P. dictyodes*).

Radula composed of 22–14–1–14–22 teeth in nearly horizontal series. Central tooth tricuspid, the mesocone attaining the anterior border of the basal-plate, side cusps small. Lateral teeth tricuspid, slightly asymmetrical. Marginal teeth also tricuspid, the entocone and mesocone united at their bases (pl. 9, fig. 36, *P. dictyodes*).

Genitalia: Penis stout, extending into a long flagellum (?), the vas deferens inserted high upon it; the stout lower portion bearing a globose appendix, at the base of which the retractor is inserted. Vagina is short, muscular and swollen. Spermatheca very large and long, its duct short; (in the figure is shown a spermatophore within it). Albumen gland small; hermaphrodite duct long, not convoluted (pl. 9, fig. 37, *P. dictyodes*).

The notable generic features of the anatomy are that *all of the teeth are tricuspid* (as in many Endodontas); *the jaw is smooth*, not vertically striated; the penis bears a flagellum and apparently an appendix. The most important shell characters are the solidity, and the callous thickening of the baso-columellar lip.

I have considered *Pararhytida* a genus separate from *Endodonta* mainly on account of the smooth jaw. In *Endodonta*, *Pyramidula*, etc., the jaw is always laminate or striate. In *Pararhytida* its component laminæ seem to be completely fused. The characters of the foot must be examined before we can intelligently discuss the systematic position of *Pararhytida*. Our knowledge of its anatomy is due to Fischer (Journ. de Conchyl., 1875).

P. dictyodes Pfr. iii, 95. P. mouensis Cr. iii, 95.
v. dictyonina Euth. viii, 134.

Section *Saissetia* (Bayle) Anc., 1889.

Shell solid, depressed-globose or subdiscoidal, the spire slightly convex; umbilicus rather narrow. *Whorls rapidly increasing, the*

last one wide, rounded at the periphery. Lip generally somewhat retracted at the upper insertion, thickened on the baso-columellar margins, dilated at the basal insertion. Surface smooth or rib-striate above. Type *H. saisseti* Montr., pl. 7, figs. 22, 23, 24.

The soft anatomy is unknown. Binney has figured the jaw and teeth of *P. astur*. The jaw is low, wide, slightly arcuate, ends hardly attenuated, blunt; anterior surface without ribs; having a wide, blunt median projection; a line of reinforcement runs parallel to the cutting edge; upper margin with a strong muscular attachment (pl. 8, fig. 7). The radula has 21–9–1–9–21 teeth. Centrals tricuspid; laterals lacking the entocone, at least on the inner teeth; marginals tricuspid, the entocone and mesocone united.

It will be seen that this differs from typical *Pararhytida* in the median projection of the jaw and the loss of entocones on the lateral teeth (pl. 8, fig. 8).

As no type was designated by Ancey, I have considered *H. saisseti* Montr. as such, for I suppose this was Bayle's intention.

Species.

P. baladensis Souv. i, 116.
P. oriunda Gass. i, 121.
P. bruniana Gass. i, 119.
P. perroquiniana Cr.
P. turneri Pfr. i, 119.
P. occlusa Gass. i, 122.
P. astur Souv. i, 117.
P. saisseti Montr. i, 117.
P. goulardiana Cr. i, 122.

Genus THYSANOPHORA Strebel & Pfeffer, 1880.

Thysanophora S. & P., Beitr. Mex. Land- und Süsswasser-Conchylien, iv, p. 30 (proposed for *impura, paleosa, conspurcatella*). —Pilsbry, Proc. Acad. Nat. Sci. Phila. 1889, p. 192.

Microphysa Martens in Albers, Die Hel., p. 82; type *Helix boothiana* Pfr. Not *Microphysa* Westw., 1834 (Hemiptera), nor of Guen. 1841 (Lepidoptera).

Acanthinula Strebel & Pfeffer, *l. c.*, p. 31, and of v. Martens, Biol. Centr. Amer., p. 130. Not *Acanthinula* Beck.—*Ptychopatula* Pilsbry, Proc. Acad. Nat. Sci. Phila. Sept. 17, 1889, p. 191; Nautilus iii, p. 62 (proposed for *cæca, dioscoricola, punctum, plagioptycha*, etc.).

Euclasta v. Martens, Jahrb. D. M. Ges. 1877, p. 347 (for *H. musicola* Sh.).—Crosse, Journ. de Conchyl. 1892, p. 14. Not

Euclasta Lederer, Verh.-Zool.-bot. Vereins in Wein, v, p. 252, 1855, and Weiner Entom. Monatschr. vii, p. 423, 1863 (Microlepidoptera).

Shell varying from flat and discoidal to depressed-globose and to conical or pyramidal; *thin;* pale brown, yellow or corneous, *somewhat translucent or at least not opaque;* narrowly umbilicated; surface rather dull, smooth or with slender riblets (generally cuticular), or densely, minutely bristly. Embryonic whorl not distinctly demarked from the after-growth, smooth or granular. Whorls 4–6½, convex, *separated by deep sutures,* the last whorl rounded or carinated. Aperture lunate or oblong; lip thin, simple or a trifle expanded, the columellar margin more or less dilated. Type *T. conspurcatella* Morel., pl. 16, fig. 3. (See also pl. 16, fig. 4, *T. cæca.* Pl. 16, figs. 5, 6, 7, *T. hypolepta.* Pl. 16, figs. 8, 9, 10, *T. stigmatica.* Pl. 16, figs. 1, 2, *T. turbiniformis*).

Foot (of *T. peraffinis*) narrow, the sole not tripartite; upper surface granulated, the tail having a median sulcus above (pl. 15, fig. 8), sides granulated, with oblique grooves but no distinctly differentiated foot-margin (fig. 9). Tail without mucus pore.

Genital system unknown, but oviduct (of *T. peraffinis*) containing several hard and brittle-shelled white eggs. *T. vortex* has been observed by Morse to be viviparous. In this genus, therefore, as in *Sagda*, both viviparous and oviparous species occur.

Jaw *thin and delicate, flexible,* strongly arcuate, *composed of many flat, narrow lamellæ, the free edges of which appear as vertical striæ;* lower margin of jaw denticulated by the lamellæ (pl. 15, fig. 7, *T. peraffinis.* Pl. 15, fig. 6, *T. turbiniformis*).

Dentition: Rhachidian tooth with square basal-plate and three stout cusps, the mesocone projecting beyond the basal-plate. Lateral teeth bicuspid, the entocone completely absent. Marginal teeth various in form; having either (1) a long oblique mesocone, and a small simple or bifid ectocone (*T. peraffinis* pl. 15, fig. 10, and also *T. incrustata, T. ingersolli*); or (2) the mesocone is bifid by union with the entocone (*T. turbiniformis* pl. 15, fig. 5, and also *T. granum, T. vortex, T. pubescens*). In *T. granum, incrustata* and *vortex* the ectocone is trifid; in the others it is either simple or bifid.

The jaws and teeth of *turbiniformis* and *pubescens,* and the teeth of *T. cæca* have been figured by W. G. Binney, Ann. N. Y. Acad. Sci. iii, pp. 105, 106, 113; those of *T. incrustata, T. ingersolli* and *T.*

vortex in Terr. Moll. v, p. 170–173, and Man. Amer. L. Sh., p. 356. The jaws and teeth of *T. perdepressa* and *T. peraffinis* have been examined by myself. All of these species have essentially the same type of jaw. The teeth vary only in the denticulation of the marginals, as noted above. The jaw is distinctly stegognathous in type, being more like that of *Flammulina* than that of *Pyramidula*.

The absence of a parapodial groove widely sunders this genus from *Pyramidula*, *Charopa*, *Phasis* and *Amphidoxa*. The first of these groups differs also in the structure of the jaw. *Thysanophora* agrees with *Hyalosagda* in characters of the jaw, dentition, foot and the calcareous-shelled eggs.

The shell of *Thysanophora* somewhat resembles that of *Pyramidula;* but it is less opaque, never flame-painted nor strongly rib-striate. The columella moreover is generally dilated as in *Trachycystis*.

The species inhabit the Greater Antilles, with a few in Bermuda, Florida and the Gulf States, and extending to the Middle American mainland from Vera Cruz and Yucatan south to Trinidad. The forms from the periphery of this area are small or minute, but in the large West Indian islands species of considerable size occur. These snails live upon the ground, under leaves or stones.

More than any other group of Antillean Helices, the *Sagda-Thysanophora-Zaphysema* group impresses us as being an original West Indian element. The other main genera of the Antilles, *Pleurodonte* and *Hemitrochus*, with the allies of each, show far-reaching affinities with Old world Helices; and *Polygyra* has been derived from the North American fauna; but not only is the *Sagda-Thysanophora-Zaphysema* group characteristic of the Antillean region now, but no Helices known to approach them in morphology of genitalia and shell have been found in any other part of the world. Thus, as far as present knowledge enables us to judge, of the three main stocks into which the West Indian Helix fauna is sharply divided, the *Thysanophora*, etc., phylum is that which has longest occupied the region, and probably developed its peculiar features therein, arising from some very early, undifferentiated Helix stock of the Polyplacognathous type. The other two great groups are much later (although still ancient) elements, which reached the Antillean tract after their essential anatomical features had become well established.

The forms of this genus are so little known anatomically that any attempt at sectional division would now be premature. By purely conchological standards, three sections are indicated: (*a*) *Thysanophora* restricted, including small forms having cuticular riblets more oblique than, and crossing, the growth-lines. This may include *Ptychopatula* (type *cæca*, pl. 16, fig. 4) which differs in being globosely elevated with only a minute umbilicus. *Acanthinula* of Strebel and v. Martens (in Biol. Centr. Amer.) is a synonym. (2) forms of the type of *vortex*, with smoother surface, the spire varying from flat to pyramidal; mostly Antillean. *T. ptychodes*, *T. turbiniformis* (pl. 16, figs. 1, 2), etc., belong here also. (3) Larger forms, with the spire mostly depressed, sometimes concave, the surface minutely roughened or bristly, such as *T. stigmatica* (pl. 16, figs. 8, 9, 10), *T suavis*, *T. velutina*, etc., from the Greater Antilles, and *T. sigmoides* from Guatemala.

Species of the mainland, Trinidad to Texas and Florida, etc.

T. conspurcatella Morel. iii, 50.
T. impura Pfr. iii, 50.
T. incrustata Poey. ii, 204.
T. ingersolli Bld. iii, 101.
T. paleosa Streb. iii, 50.
T. granum Streb. iii, 55.
T. ierensis Gupp. iii. 55.
T. plagioptycha Sh. ii, 174.
T. dioscoricola C. B. Ad. ii, 174.
T. cæca Guppy. iii, 55.
T. bactricola Guppy. iii, 55.
T. hornii Gabb. iii, 21.
T. venezuelensis Jouss. viii, 112.
T. rojasi Jouss. viii, 112.
T. vortex Pfr. iii, 93.
T. turbinella Morel. iii, 51.
T. cæcoides Gupp. iii, 55.
T. guatemalensis C. & F. ii, 174.
T. coloba Pils.
T. punctum Morel. iii, 53.
T. intonsa Pils. viii, 111.
T. sigmoides Morel. iii, 101.
vitrinoides Tristr.

[Of the above species, *T. granum* and *ierensis* are probably mere varieties of *plagioptycha*, and *T. cæca* and *punctum* varieties of *dioscoricola*. Specimens of all the above, except *turbinella*, *guatemalensis*, *venezuelensis*, *rojasi* and *punctum* are in the collection of the Academy.]

Species of the West Indies and Bermuda.

T. alveus C. B. Ad. iii, 98.
T. angustispira C. B. Ad. iii, 97.
T. anthoniana C. B. Ad. iii, 96.
T. musicola Shutt. iii, 97.
v. major Crosse.
T. peraffinis C. B. Ad. iii, 98.

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T. arecibensis Pfr. iii, 58.
T. boothiana Pfr. iii, 97.
v. vitrina C. B. Ad. iii, 97.
T. brevior C. B. Ad. iii, 99.
depressa Ad.
T. cyclostomoides Pfr. iii, 100.
T. debilis Pfr. iii, 101.
fragilis Pfr.
T. desiderata Pfr. iii, 96.
T. diminuta C. B. Ad. iii, 99.
T. dioscoricola C. B. Ad. ii, 174.
T. elatior Weinl. & Mts. iii, 97.
T. euclasta Shutt. iii, 97.
swifti Pfr.
T. fuscula C. B. Ad. iii, 98.
T. gracilis Poey.
T. hilum Weinl. & Mts.
T. hypolepta Shutt. viii, 111.
T. immunda C. B. Ad. iii, 99.
T. inaguensis Weinl. iii, 41.
T. inconspicua C. B. Ad. iii, 99.
T. incrustata Poey, ii, 201.
incrassata Rve.
saxicola Gld.
T. jeannereti Pfr. iii, 53.
T. krugiana Mart.
T. leucoraphe Pfr. iv, 77.
T. montetaurica Pfr. iii, 97.
T. perdepressa C. B. Ad. iii, 100.
T. plagioptycha Shutt. ii, 174.
T. portoricensis Pfr. iii, 96.
T. prominula Pfr.
T. pruinosa Pfr. iii, 186.
T. ptychodes Pfr. iii, 100.
T. pubescens Pfr. iii, 184.
T. raripila Morel. iii, 101.
T. rufula Pfr. iii, 99.
T. sincera C. B. Ad. iii, 99.
T. spreta C. B. Ad. iii, 98.
v. errans Ad. iii, 98.
T. stigmatica Pfr. iii, 100.
T. suavis Gundl. iii, 100.
T. subaquila Shutt. iii, 98.
T. tichostoma Pfr. iii, 100.
lamellina Newc.
T. translucens Gundl. iii, 96.
T. turbiniformis Pfr. iii, 96.
subpyramidalis C. B. Ad.
macnabiana Chitty.
pyramidatoides d'Orb.
T. velutina Lam. iii, 100.
T. virescens Pfr. iii, 96.
T. vortex Pfr. iii, 98.
selenina Gld.
otellina Röse.
v. bracteola Fér.

Genus SAGDA Beck, 1837.

Sagda Beck, Index Molluscorum p. 9 (for *alveolata* B. and *australis* Ch. B.).—Albers-Martens, Die Hel. p. 76.—Shuttleworth, Bern. Mittheil. 1853, p. 85.—See also Binney, Ann. N. Y. Acad. Sci. iii, p. 88.—Semper, Reisen im Archip. Phil., Landmoll., p. 128, and Pilsbry, Proc. Acad. Nat. Sci. Phila. 1892, p. 213.—*Epistilia* Swains. Malacol., p. 165, type *E. conica* Swains., *l. c.*, f. 18*a* [=*S. jayana*?].—*Epistyla* Swains., *l. c.*, p. 331, type *E. conica* Sw. [=*S. cookiana*!].

+*Hyalosagda* Alb. and *Odontosagda* Martens, Die Hel., p. 77, 78.

Shell having *the texture of Zonites or Hyalinia*, imperforate or umbilicate, varying in form from depressed and subdiscoidal to globose-conic or trochoidal; whorls 6–9, *narrow* and slowly increasing, *the last not deflexed in front.* Aperture nearly vertical, lunate, either with or without internal laminæ; *lip thin, sharp and simple,* slightly dilated or reflexed at the axis; columella short, having a callous fold, or thin and simple. Type *S. cookiana* Gmel., pl. 16, figs. 11, 12, 13. (See also pl. 16, figs. 14–20).

Animal viviparous, or oviparous with hard-shelled eggs.

Foot extremely long and narrow (the sole in *S. similis* measuring length 20, width 3 mill.), strongly granulated above, *the tail having an impressed median longitudinal line or groove,* acute behind; sides of foot without longitudinal grooves, but marked by a zigzag line (pl. 35, fig. 7); sole not divided longitudinally (pl. 35, fig. 8, *S. similis*).

Genital system much elongated, the vestibule short. Penis long, the vas deferens *and a flagellum* inserted at its apex (pl. 35, fig. 2), and *an elongated appendix* inserted at the lower third (appendix of *S. similis* seen convoluted in the normal manner in pl. 35, fig. 2, partially straightened out in pl. 35, fig. 3). Vagina long and narrow; uterus larger, containing eggs or young shells; *duct of spermatheca very long,* expanded near the base (pl. 35, fig. 4, *S. similis*). See also pl. 21, fig. 9, penis of *S. cookiana*, *p.* penis, *a.* appendix, *r. p.* retractor muscle, *fl.* flagellum. Fig. 10 shows the appendix partially uncoiled.

Jaw thin, arcuate, smooth, with a slight median projection or none in *S. foremaniana, haldemaniana, jayana* and *cookiana* (pl. 21, fig. 8). In *S. similis* (pl. 35, fig. 6) it is thin, arched, and of the stegognathous type, being composed of 27 narrow flat vertical plates, soldered together, the outer imbricating edges of which are distinctly visible.

Radula having the transverse rows of teeth nearly straight. Central teeth having a square basal-plate and three cusps, the mesocone longer than the basal-plate. Lateral teeth bicuspid, the mesocone long. Marginal teeth also bicuspid. (Pl. 21, fig. 7, *S. cookiana;* pl. 35, fig. 5, *S. similis*; pl. 35, fig. 1, *S. haldemaniana*).

The jaw of *foremaniana* has been described by Semper, that of *haldemaniana* and *jayana* by Binney, that of *cookiana* by myself; all agree in being smooth (oxygnathous) as described above. The jaw of *S. similis,* examined by the writer, is of the plaited type. The teeth of *foremaniana* are described by Semper, those of *connectens,*

haldemaniana and *jayana* by Binney. All agree with the description given above, and with those of *S. similis* and *S. cookiana* examined by the writer.

The prominent features of the shell in this genus, are its *Zonites*-like texture, the subvertical aperture, and sharp simple lip. The genital system is peculiar for its appendix and flagellum on the penis, and the long spermatheca duct. The teeth of the species investigated agree in the long mesocones, constantly present ectocones, and bicuspid marginals. The jaw in the typical forms is smooth, by the complete union of its component laminæ; in the section *Hyalosagda*, which is nearer the ancestral stock, the jaw shows vertical imbricating plates, as in *Thysanophora*, *Flammulina*, etc.

The genus *Sagda* is by no means so isolated in the family of Helices as has been supposed. Its relationship with *Thysanophora* and especially with *Zaphysema*, is moderately intimate.

The analogy of the shell of *Sagda* with that of the Zonitid genus *Gastrodonta* is remarkable. Both contain forms with spiral internal laminæ, and depressed forms without laminæ; the section *Hyalosagda* being quite comparable to the section *Zonitoides*. *Gastrodonta* too, has elevated forms (*G. ligera*, etc.) recalling *Sagda* in contour.

Sagda is confined to the island of Jamaica, with the exception of the subgenus *Odontosagda* inhabiting Haiti and Cuba. The species and forms are numerous, extremely variable, and correspondingly difficult to determine. This difficulty is enhanced by the fact that some of the best specific characters can be seen only by breaking an opening in the last whorl a half volution behind the aperture; the vicinity of the suture being the best place for the incision. By this means only may the form and length of the lamellæ be observed, as is the case with *Plectopylis* and some other groups. The lamellæ are present in young specimens, but are progressively absorbed as the animal grows, so that in adults they do not extend inward much beyond the last whorl. The basal lamina is sometimes totally absent in species normally possessing it, just as in *Gastrodonta*; but as in that genus, it is a comparatively rare condition in most species.

Subdivisions.

Section *Sagda* (restricted). Shell *imperforate*, the axis solid; aperture having a spiral lamina within the last whorl and generally a fold on the columella. Type *S. cookiana*, pl. 16, figs. 11–13. (See also pl. 16, figs. 16, 17, *S. connectens*, and pl. 16, figs. 14, 15, *S. alligans*.)

Animal *viviparous*, the young at birth being depressed-globose, flattened above, thin, translucent, perforated; composed of $2\frac{1}{2}$ whorls; measuring nearly one-fifth the diameter of the adult. We have observed young shells in specimens of *cookiana*, *foremaniana* and *ambigua*.

Section *Hyalosagda* Martens. Shell perforate or umbilicate, glassy, thin and depressed. Aperture with no internal lamellæ or teeth. Type *S. similis*, pl. 16, figs. 18, 19, 20.

Animal *oviparous*, the eggs short-oval, with a hard, white, smooth calcareous shell; the length of its longest axis contained 5 to 6 times in the diameter of the shell. We have found eggs in *S. haldemaniana* and *S. similis*.

Subgenus Odontosagda Martens. Small, thin and *umbilicated;* internal laminæ interrupted; columella thin.

The extreme difficulty of the genus, and the inadequacy of the accounts of it in the works of Pfeiffer, Reeve and Tryon, induce me to offer the following key to the species. Shuttleworth has published an excellent revision of the group. All known Jamaica species are represented in the collection of the Academy.

Key to the species of Sagda.

I. Aperture provided with internal teeth or laminæ.

a. Basal lamina either interrupted, or less than $\frac{1}{2}$ whorl in length; base *very* convex; form subglobose or globose-conic.

b. Base deeply impressed at columella; basal lamina interrupted.

c. Globose-conic; solid, strong, yellow; columellar fold weak or *obsolete; basal lamina interrupted forming several teeth;* whorls 9; alt. 21, diam. 22 mill. *cookiana.*

bb. Base not deeply impressed; basal lamina continuous; columella with a nodule-like fold.

c. Globose-pyramidal; *base globosely convex, not impressed* at columella; solid, strong, yellow; columellar fold a strong nodule, *not entering; basal lamina very strong,* $\frac{1}{3}$

whorl long; whorls 7; alt. 16–18, diam. 17 mill. *foremaniana.*

cc. Globose; thin, subtranslucent, corneous; base globosely convex, hardly impressed; columellar fold strong and heavy, *spirally entering;* basal lamina strong, *short,* one-fourth whorl long; whorls 6; alt. 12, diam. 12–13 mill. *pila.*

ccc. Globose-subconic; thin but rather solid, translucent; base very convex, only slightly impressed; columellar fold a stout nodular callus, somewhat entering; basal lamina strong, about ⅓ whorl long; *an additional small fold developed between basal and columella folds;* whorls 6–7; alt. 16, diam. 16 mill.; alt. 11, diam. 13 mill. *triptycha.*

aa. Basal lamina ⅓ to ½ whorl long, continuous; base not notably convex.

b. Large, solid and elevated.

c. Trochoidal; *base not excavated in the middle;* no columellar fold; basal lamina deep-seated, about ⅓ whorl long; whorls 8; alt. 24–26, diam. 27–30 mill. *alligans.*

cc. Elevated trochoidal; *base deeply excavated* in the middle; columellar fold and basal lamina strong within, spirally entering, but sometimes neither is visible from the aperture; whorls 9; alt. 25, diam. 27–28 mill.; alt. 18, diam. 24 mill. *jayana.*

bb. Small, thin, depressed.

c. Depressed-subglobose, thin, subtranslucent greenish-yellow, *the surface minutely spiculose;* base slightly excavated; columella calloused; *lamina peripheral in position, extending nearly to lip-edge;* whorls 6; alt. 9, diam. 13 mill. *lamellifera.*

cc. Subdiscoidal, thin, *translucent,* polished; base excavated; columella calloused; *basal lamina not deep-seated,* ⅓–½ *whorl long;* whorls 6½; alt. 6⅓, diam. 11 mill. *osculans.*

aaa. Basal lamina one whorl long or more.

b. Lamina peripheral in position, *lamellifera.*

bb. Lamina basal in position.

c. *Much depressed*-trochoidal, solid, somewhat translucent, smooth; *base but little excavated;* columellar fold small or obsolete; basal lamina more than a whorl long; whorls 7½–9; alt. 16, diam. 23–25 mill. *connectens.*

cc. Trochoidal, solid, strong, *costulate-striate above the periphery;* no columellar fold; basal lamina a full whorl long; whorls 7; alt. 17, diam. 20 mill.; alt. 13, diam. 16 mill. *epistylioides.*

ccc. Globose-trochoidal, solid, strong; *base somewhat excavated;* columellar fold *strong and lamellar within;* basal lamina strong, about one whorl long; whorls 8; alt. 18, diam. 19 mill. Smaller and paler than *jayana*, with less excavated base, but probably a variety of *jayana.* *alveare.*

cccc. Elevated trochoidal, solid, strong and opaque; *base deeply excavated;* columellar fold and basal lamina strong within, but often not visible from the aperture; whorls 9; alt. 25, diam. 27–28 mill.; alt. 18, diam. 24 mill. *jayana.*

ccccc. Globose-trochoidal, solid but thin, *covered with a yellow cuticle bearing minute spicules or pitted;* base depressed, excavated; columella with a strong lamellar fold; basal lamina long; whorls 8; alt. 12, diam. 14½ mill. *spiculosa.*

cccccc. Elevated, *pyramidal*, solid, subtranslucent; upper whorls finely costulate-striate; base narrowly and *but little excavated*; columella having *a blunt callous fold, spirally entering*; basal lamina strong, about one whorl long; whorls 8–9; alt. 17, diam. 16 mill., *torrefacta.*

II. Aperture lacking internal teeth or laminæ.

a. Umbilicus moderate, its breadth contained 9–15 times in diameter of shell.

b. Diam. 13–16, alt. 7–9 mill. *similis.*

bb. Diam. 9–10, alt. 5–5½ mill. *hollandi.*

bbb. Diam. 3–4, alt. 1⅓–1½ mill. *brevis.*

aa. Umbilicus reduced to a perforation partly closed by the reflexed columella, or wholly closed and imperforate.

b. Imperforate; base depressed; alt. 11½–12, diam. 5½–7 mill. *osculans v. delaminata.*

bb. Perforated; base convex, well impressed in the middle.

c. Diam. 11–12 mill. *haldemaniana.*

cc. Diam. 9–10 mill. *ambigua.*

Species of Sagda.

[See pl. 16, figs. 11–13, *S. cookiana*; pl. 16, figs. 14, 15, *S. alligans*; pl. 16, figs. 16, 17, *S. connectens*; pl. 16, figs. 18–20, *S. similis.*]

S. cookiana Gmel., iii, 6.
australis Chem., auct.
conica Swains.
epistylium Dillw., Sowb.
foremaniana Rve.
S. foremaniana C. B. Ad., iii, 7.
S. pila C. B. Ad., iii, 8.
S. triptycha Shuttl., iii, 7.
S. alligans C. B. Ad., iii, 6.
epistylium Pfr. & Rve., not
? alveolata Beck. [Müll.
S. connectens C. B. Ad., iii, 6.
S. osculans C. B. Ad., iii, 8.
v. delaminata Ad.
S. ambigua C. B. Ad., iii, 9.
S. lamellifera C. B. Ad., iii, 8.
S. epistylioides Fér., iii, 6.
S. jayana C. B. Ad., iii, 6.
? alveolata Beck (undesc.).
cookiana Pfr.
alligans Rve.
sayana Alb.-Martens.
? conica Swains.
S. alveare Pfr., iii, 7.
S. spiculosa Shuttl., iii, 7.
S. torrefacta C. B. Ad., iii, 7.

(Section *Hyalosagda*).

S. similis C. B. Ad., iii, 9.
S. haldemaniana Ad., iii, 8.
arboreoides Ad.
S. hollandi C. B. Ad., iii, 9.
S. ? brevis C. B. Ad., iii, 9.

Subgenus ODONTOSAGDA Martens, 1860.

Odontosagda MARTENS, in Albers, Die Hel., p. 78.

Shell small, depressed, thin, whitish, smooth, *umbilicated*, with 5–6 convex narrow whorls; base convex. Aperture subvertical, lunate, the lip thin and simple; *interior having upon the basal wall several spiral laminæ interrupted into teeth*, or with such a spiral lamina and a series of transverse blades; *columella thin, not calloused nor toothed.* Type *S. polyodon* (see pl. 20, figs. 35, 36, *S. hillei* Gundl.).

Anatomy unknown. Distribution, Haiti and eastern Cuba. This group differs from the toothed Sagdas of Jamaica in the perforated or umbilicate shell and the interrupted laminæ.

S. polyodon Weinl. & Mart. ii, [201. S. blandi Weinl. iii, 8.
S. hillei Gundl. ii, 199.

Species erroneously referred by authors to Sagda: H. epistyliulum C. B. Ad. is a *Guppya*. *H. circumfirmata* and *discrepans* belong to the *Zonitidæ*, genus *Pœcilozonites*.

Genus ZAPHYSEMA Pilsbry, 1894.

Cysticopsis, in part, of authors.

Shell globose, thin, unicolored brownish, smooth except for slight growth-wrinkles; imperforate, the axis solid; composed of 5 to 6 convex whorls the embryonic shell consisting of two whorls, its junction with the after-growth marked by an indistinct oblique line; *the last whorl much wider, large and inflated*, hardly deflexed in front. Aperture large, round-lunate, moderately oblique, and toothless; the *lip thin, sharp and simple*, dilated and closely appressed at the white-calloused columella. Type *Helix tenerrima* C. B. Ad., pl. 16, fig. 21.

Foot black, rather short, granulated and obliquely grooved above, as in *Thysanophora* and *Sagda*, the tail obtuse, having a median longitudinal groove above; anterior half of the foot traversed on each side by an obliquely descending groove arising about the middle of the mantle insertion. Sole indistinctly tripartite.

The figures of the foot of *Thysanophora peraffinis* (pl. 15, figs. 8, 9, upper and lateral views) well represent that of *Z. tenerrima* also.

Genital system having a short vertibule. Penis long, the vas deferens inserted near the apex, where *a long flagellum* and a curved appendage are inserted; at the lower third of the penis arises an

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appendix, which seems to be glandular, and terminates in two long flagellum-like organs; the retractor-muscle arises from a median dilation of the penis. Vagina short, narrow; uterus enormously distended with young shells. Spermatheca globular, situated on *a very long duct*, which is apparently branched (pl. 35, fig. 12, *Z. tenerrima*).

Jaw wide, arcuate, with a slight median projection; composed of narrow vertical flat plates soldered together, their outer imbricating edges appearing as delicate spaced vertical striæ; above projects a narrow conical process, springing from the middle of its surface (pl. 35, fig. 10, *Z. tumida*).

Radula composed of short teeth with square basal-plates. Centrals having the mesocone about as long as the basal-plate, and very broad, side cusps small but well developed. Lateral teeth similar, but lacking entocones. Marginal teeth low and wide, the mesocone large, sometimes bifid at the apex; ectocone simple or bifid (pl. 35, fig. 11, *Z. tenerrima*; pl. 35, fig. 9, *Z. tumida*).

Distribution, Jamaica.

The shell in this genus is globose, with large body-whorl, spire convex or low-conoidal, lip sharp and thin. The jaw is like that of *Thysanophora* and *Sagda* in structure, being of the stegognathous type. The dentition closely resembles that of the two genera named, but in *Sagda* the mesocones are longer. The foot in the three genera *Thysanophora*, *Sagda* and *Zaphysema* is practically the same in structure. The genital system is similar in general features to that of *Sagda*. The modes of reproduction are identical in the three groups.

Binney has examined the jaw and teeth of *Z. tumida*; the writer has figured the teeth and genitalia of *Z. tenerrima*. The other species are still unknown anatomically.

The group *Cysticopsis*, in which these forms have hitherto been placed, differs widely from them in anatomical features. It must be included in the genus *Hemitrochus* as a sectional division.

In the single individual of *Z. tenerrima* examined, the thin-walled uterus contained 27 young shells, and an egg, which was globular, with thin brittle white shell. The young shells are depressed-globular, translucent, often iridescent, and measure alt. 1·5, diam. 2 mill.; whorls two. It would seem that in *Thysanophora*, *Sagda* and *Zaphysema* eggs are normally formed, having the shell hard and calcareous. In some species of each group the eggs

develop and hatch within the uterus, the young snails consume their egg-shells, using the lime for shell-building; they attain a growth of about two whorls or more before birth. In other species this prolongation of the antenatal period has not been established, and hard-shelled eggs are brought forth.

Species of Zaphysema.

Z. macmurrayi C. B. Ad., v, 7.
Z. buddiana C. B. Ad., v, 7.
Z. munda C. B. Ad., v, 9.
Z. tumida Pfr., v, 8.
tunicata C. B. Ad.
Z. tenerrima C. B. Ad., v, 8.
Z. columellata C. B. Ad. v, 9.

* * *

Genus PRATICOLELLA v. Martens, 1892.

Praticola Strebel & Pfeffer, Beitr. Mex. Land- und Süssw. Conch. iv, p. 38, 1880, type *P. ocampi*. Not *Praticola* Swains., 1837.—*Praticolella* v. Mart., Biol. Centr. Amer., Moll., p. 138.—*Dorcasia* Binney, Terr. Moll. v, p. 346, not of Gray.—See for anatomy, W. G. Binney, *l. c.*; Semper, Phil. Archip. p. 246; Strebel & Pfeffer, *l. c.*

Shell of the ordinary *Helix* shape; narrowly umbilicated, globose, shining, *opaque white or yellowish with translucent corneous and brownish spiral bands*, the most constant band supraperipheral in position. Aperture lunate-rounded, slightly oblique, lip narrowly reflexed, dilated at the columellar insertion, sometimes thickened within. Type *P. ampla* Pfr. (see pl. 20, figs. 26, 27, *P. griseola*; pl. 20, fig. 28, *P. berlandieriana*; pl. 20, figs. 29, 30, 31, *P. flavescens*).

Mantle having both right and left body-lappets; sole indistinctly tripartite, the central area not sharply separated from the sides, but darker colored (in spirit).

Genitalia (pl. 21, figs. 1–4, *P. ocampi=ampla*) Female organs as in Polygyra, *without dart sack, mucus glands or other accessory organs*; spermatheca oval, its *duct simple and very short.* Penis large, the vas deferens inserted at its apex; *retractor trifid*, one branch inserted at apex and one at middle of penis, with a small branch to vas deferens (fig. 2). Cavity of penis containing a tongue shaped papilla (pl. 21, fig. 3), inserted near apex of cavity; a fleshy ridge arising at the insertion of the vas deferens runs nearly to the base of penis. At the lower third of the penis is inserted *a large, club-shaped appendix*,

opening into the penis by a narrow aperture, and containing two strong longitudinal fleshy ridges (pl. 21, fig. 3). Talon coronated (pl. 21, fig. 4).

Jaw arcuate without median projection, sculptured with numerous (12–14) broad, crowded ribs, denticulating both margins. (pl. 21, fig. 5, *P. ampla*).

Radula having the central teeth tricuspid, mesocones with a long reflection, the cutting points projecting beyond the basal-plates, ectocones shortly reflected with long cutting points. Laterals similar but lacking entocones. Marginal teeth low, wide, the mesocone and ectocone both bifid (pl. 21, fig. 6, *P. griseola*).

Distribution: eastern Mexico and Texas. The species live in open fields and chaparral.

The most important anatomical features of this group are the simplicity of the female generative system, which is like *Polygyra* in its short spermatheca duct, lobed talon and other characters; the male system being also like *Polygyra* except that the retractor has a triple insertion, and the penis has a large appendix. Jaw as in *Polygyra*, section *Stenotrema*; teeth of radula as in *Polygyra*. External features also like *Polygyra*. Our knowledge of the anatomy is due to the investigations of Leidy, Binney, Semper and Pfeffer. Von Martens is in error in attributing a dart sack to this group, and in placing it as a subgenus under *Helix* s. str.; it is intimately allied to *Polygyra*, the large appendix and split penis retractor being the only anatomical features separating *Praticolella* from *Polygyra*, the texture of the shell offering another differential feature.

P. ampla Pfr.
ocampi Streb. iv, 76.
P. flavescens (Wiegm.) Pfr., iv, [75.
P. berlandieriana Moric. iv, 76.
pachyloma Mke.
P. griseola Pfr., iv, 76.
cicercula Fér., Dh.
pisum Beck.
albocincta Binn.
albozonata Binn.
albolineata Gld.
splendidula Ant.

Genus POLYGYRA Say, 1818.

Polygyra Say, Journ. Acad. Nat. Sci. Phila. i, p. 278 (proposed for *auriculata*, *avara* and *septemvolva*).—Pilsbry, Proc. Acad. N. S. Phila. 1889, p. 193; 1892, p. 400.

Plus Dædalocheila Beck, Index, p. 21 (for *auriculata*, *avara* and *implicata*).—*Triodopsis* Rafinesque, Journ. de Phys., etc., lxxxviii,

p. 425, 1819; Enum. and Acct. etc., p. 3, 1831 (type *Tr. lunula,=H. tridentata* Say). +*Menomphis* Raf., *l. c.*—*Xolotrema* Raf., *l. c.*, (proposed for *X. lunula, X. triodopsis* and *X. clausa*, all undescribed and unidentified).—*Odotropis, Chimotrema* and *Toxotrema* Raf., Journ. de Phys., *t. c.*, p. 425 (?=*Stenotrema*).—*Stenotrema* Raf., *l. c.* (type *S. convexa=H. stenotrema* Fér.).—*Aplodon* Raf., *l. c.* (type *A. nodosum*; undescribed and unidentified).—*Stenostoma* Raf., Enum. and Account, 1831 (type *S. convexa* Raf.). *Mesodon* Raf., *l. c.* (type *M. maculatum* Raf., unidentified).—*Trophodon* and *Odomphium* Raf., *l. c.* unidentified.—*Ulostoma* Albers, Die Hel. 1850, p. 95 (=*Polygyra s. str., Stenotrema, Triodopsis*, etc. Not *Ulostoma* Tryon!).—*Patera* Albers, *l. c.*, p. 96 (=*Mesodon* auct.).—*Cyclodoma* Swains. (part), Malacol., p. 193.—*Tridopsis* Beck, Index Moll., p. 22; Gray, P. Z. S. 1847, p. 173, type *H. plicata*.

Helicodonta (in part) Fer., Prodrom., p. 33.—*Anchistoma* (in part) H. & A. Ad., Gen. Rec. Moll. ii, p. 205, 1858.—*Angystoma* (in part) Klein, Tent. Meth. Ostr., p. 10, 1753 (pre-Linnæan).

Neohelix v. Ihering, Zeitschr. f. Wissensch. Zool. liv, p. 482, 1892 (=*Polygyra* Pils.).

Conf. W. G. Binney, Terr. Moll. v, and Strebel & Pfeffer, Mex. Land- u. Süsswasser-Moll. (anatomy).

Shell helicoid, varying from globose or depressed-globose to lens-shaped or planorboid, the periphery carinated or rounded; umbilicus either open or closed. Surface striated or hirsute; corneous, yellow or brown, generally unicolored, but sometimes with many bands, *the most constant being supra-peripheral*, the others when present being wholly indefinite in number and position. *Lip well reflexed; aperture typically obstructed by three teeth*,—one parietal, two upon the lip; but *any or all teeth often wanting*.

Animal externally as in Helix, the mantle subcentral, foot rather long and narrow, *not distinctly tripartite below*, and without longitudinal grooves above the lateral margins, although a sort of foot-margin is produced by the tessellated granulation of the edge. Surface rather coarsely irregularly granulated, the granulation finer posteriorly; back with a pair of indistinct grooves extending from mantle to facial area; *sides of foot, and sides and top of tail without any distinct oblique or longitudinal lines, irregularly granulated;* tail rounded above, obtuse behind. Mantel edge reflexed to correspond with the lip of the shell, its edge even; shell lappets none; body-

lappets small, the right one long, giving off a short ascending branch behind the lung-pore; left lappet very small, short.

Genitalia *completely lacking accessory organs;* retractor and vas deferens inserted at the apex of the penis. Spermatheca oval or oblong, *situated upon a short simple duct* (pl. 30, fig. 6, *P. troostiana*; pl. 30, fig. 12, *P. inflecta;* pl. 30, fig. 20, *P. clausa*; pl. 31, fig. 27, *P. spinosa*; pl. 21, figs. 12–16, *P. albolabris*). The penis is divided internally into two parts: (1) a lower, invertible portion, the inner surface of which shows few or many longitudinal folds, which are smooth and may be either weak or strong and acute; and (2) an upper portion the cavity of which has finely corrugated walls and is partially filled by one or two fleshy pillars adherent along the sides.

Jaw arcuate, solid and strong, sculptured with 7 to 20 strong convex ribs; cutting edge without median projection, but denticulated by the ribs (pl. 30, fig. 19, *P. sayi* Binn.; pl. 30, fig. 21, *P. kiawaensis* Simp.; pl. 21, fig. 11, *P. albolabris* Say).

Distribution: North America (exclusive of some parts of the southwestern U. S.); Cuba, Bahamas and Bermuda.

The white-lipped Helices of North America form a very distinct and homogeneous genus, well distinguished by characters of the shell and still more by those of the soft parts. The group, in practically its present limits, was first defined in 1889, by the writer; subsequently the European forms supposed by former authors to be allied to *Triodopsis* were shown to differ generically (Journ. de Conchyl. 1891, p. 22). Dr. H. v. Ihering has more recently discussed the genus, under the new name, *Neohelix* (Zeitschr. f. wissenschaftl. Zool. 1892, p. 482). This name must be considered superfluous, on account of the priority of no less than twenty other more or less available generic or subgeneric names proposed by various authors.

No snails referable to *Polygyra* have been found in any part of the Old World, or in South America, either living or fossil. It is therefore highly probable that the genus arose and developed its peculiarities upon eastern North American soil. The West Indian species are to be regarded as stragglers from the continental fauna, just as *Hemitrochus, Liguus* and *Thysanophora* in Florida are emigrants from the Antillean fauna. A former connection between southern Florida and the Great Antilles is demonstrated by the Pliocene fauna of the former; but the connection was probably not direct,

but by way of the Bahama bank, which had previously been connected with Cuba and Haiti.

The question of the relationships of *Polygyra* is beset with difficulties. I had formerly grouped the genus with *Pyramidula*, etc. but the characters of the foot peremptorily forbid such association. Dr. v. Ihering suggests the possibility that it may be either a modified branch of *Arionta* in which the genitalia have become simple by degeneration, or a further development of *Patula*. The latter hypothesis is untenable. The former has as yet no facts to support it.

No fossils now known throw light upon the problem. From what we know of the living forms of *Polygyra*, it is likely that their common ancestor possessed a shell with tridentate aperture, reflected lip, and a color-band above the periphery. It is not unlikely that the group represents an early stage of the true *Helix* phylum, which did not share the evolution of the accessory organs of the genitalia now characteristic of the *Pentatænia*, *Campylæa*, *Cochlostyla*, etc.

Polygyra divides into three sections, typically very distinct in in appearance, but closely connected by more or less intermediate species. The anatomy is practically the same throughout.

Section *Polygyra* Say, (restricted).

Shell depressed; umbilicated, or having a curved groove caused by the tangential deviation of the last whorl. Aperture somewhat kidney-shaped or ear-shaped, *the lip continued in an elevated v-shaped callus across the parietal wall*; outer lip having two teeth or none. Type *P. septemvolva* Say, pl. 30, figs. 1, 2, 3. (See also pl. 30, fig. 4, *P. auriculata* Say).

Central teeth tricuspid, the side cusps well developed; laterals bicuspid; marginal teeth generally having the mesocone bifid at tip, at least on the extreme margin of the radula, ectocone simple (pl. 30, fig. 5, *P. septemvolva*; pl. 30, fig. 7, *postelliana*). Genital system as described above (pl. 30, fig. 6, *P. troostiana*).

This section comprises some very aberrant species, but the extremes are so closely connected by intermediate forms that no useful subdivisions can be maintained. The synonymy of the restricted section *Polygyra* comprises the names *Dædalocheila*, *Ulostoma* and *Cyclodoma*.

The species inhabit the Southern States, a few ranging as far north as South Carolina, Kentucky and Missouri, extending southward throughout Mexico. In the West Indies species are found in the

Bermudas, Bahamas and Cuba. Most species, such as *cereolus, auriformis, mooreana*, etc. are gregarious, and occur in great numbers. All are ground snails, living at the roots of grass, or under bits of wood or leaves; and while some forms such as *auriformis* are found only in the immediate proximity of water, others occur in very dry situations, the arid mesquite chaparral of southern Texas being inhabited by *texasiana* and *mooreana*.

Species without teeth on the outer lip.

Bland has published an excellent essay upon these forms in Annals N. Y. Lyceum vii, 132, 1860, but his material was not extensive enough to show the intermediate forms now known. The forms included under *P. cereolus* are absolutely connected by a series of transitions, in which the supposed specific characters found in the striation or ribbing, the degree of carination, number of whorls, form of umbilicus and presence or absence of an internal lamina, blend by imperceptible degrees.

The typical *cereolus* is found on the Florida keys and adjacent mainland; it passes into the smaller form *carpenteriana*, which continues up the coast, mainly westward; occurring also at Matanzas, Cuba! In central and eastern Florida *septemvolva* occurs, its small race *volvoxis* spreading north to St. Simon's I., Georgia, and to the west (under the name *febigeri*) it occurs at New Orleans, La., and Galveston, Texas. Var *microdonta*, which is typically quite distinct in its fine striation, occurs abundantly in Bermuda, and also on New Providence (at Nassau), Bahamas. At the latter locality transition forms occur; and it must also be noted that some specimens of *volvoxis* from Florida (Tampa) and *carpenteriana* (Key Biscayne) show striation equally fine. Species of this group inhabit the neighborhood of the sea, and generally occur in great numbers. Besides the species enumerated below there is another *Polygyra* with toothless outer lip, *P. anilis*; but its relationships are with an entirely different group of forms.

(*Key to species and varieties*).

a. Parietal tooth minute, not connected with columellar lip by a raised callus; no internal lamina. *paludosa.*

aa. Parietal tooth connected with a raised parietal callus.

b. Internal lamina present; upper surface strongly ribbed.

c. Size large; whorls 7–10. *cereolus.*

cc. Size small; whorls 6, the last contracted in its first half, its last half notably swollen. *carpenteriana.*

bb. No internal lamina.

c. Upper surface coarsely ribbed.

d. Size large, whorls 7 or more. *septemvolva.*

dd. Size smaller, whorls 5½–7, *volvoxis.*

cc. Upper surface very finely striated. *microdonta.*

P. cereolus Mühlf., iii, 128.
laminifera W. G. B.
f. carpenteriana Bld.
microdonta W. G. B., *olim.*
f. septemvolva Say.
planorbula Lam.
polygyrata " Binn." Pfr.
f. volvoxis Pfr.
febigeri Bld.
f. floridana Hemph.
Var. microdonta Desh.
delitescens Shutt., undesc.
cheilodon Say, Bld.
? plana Dkr.
P. paludosa Pfr. iii, 129.
lingulata Fér., Dh.
ramonis d'Orb.
ramondi d'Orb., Atlas.
insularum Beck, undesc.
? bardenflehtii B., Villa.

Species with teeth on the outer lip.

With the exception of *P. johannis* of Cuba, the species of this section are all continental. The *auriculata* series inhabits the southern tier of Gulf States, from Florida to Texas; the *dorfeuilliana* series is confined to the more or less mountainous region south of the Ohio River, from Tennessee to Oklahoma; the *texasiana—acutedentata* series is from Mexico, extending into Texas along the northern continuation of the Sonoran fauna and flora.

P. auriculata Say, iii, 137.
v. microforis Dall, iii, 138.
P. uvulifera Shutt., iii, 137.
florulifera Rve.
P. auriformis Bld., iii, 137.
? sayii Wood, DeKay.

* * *

P. hazardi Bld., iii, 131.
plicata Say.
? finitima Dh.
P. dorfeuilliana Lea, iii, 133.
v. sampsoni Weth., viii, 152.
P. postelliana Bld., iii, 137.
P. espiloca (Rav.) Bld., iii, 136.
P. avara Say, iii, 136.
P. pustula Fér., iii, 131.
P. pustuloides Bld., iii, 132.
P. leporina Gld., iii, 131.

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P. fastigans Say, iii, 131.
fatigiata Say.
fastigiata DeK.
P. jacksoni Bld., iii, 134.
v. deltoidea Simp., viii, 152.
P. troostiana Lea, iii, 131.

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P. implicata (Beck) Mart. iii, [133.
P. oppilata Morel, iii, 133.
P. dysoni Shuttl., iii, 132.
dorfeuilliana Pfr. not Lea.
P. chiapensis Pfr., iii, 138.
P. mooreana W. G. B., iii, 135.
v. tholus W. G. B., iii, 135.
P. yucatanea Morel., iii, 146.
v. helictomphala Pfr., iii, 130.
P. plagioglossa Pfr., iii, 133.
P. dissecta v. Mart., viii, 151.
P. couloni Shuttl., iii, 134.
P. bicruris Pfr., iii, 136.
P. richardsoni v. Mart., viii, 151.
P. ventrosula Pfr., iii, 136.
v. hindsii Pfr., iii, 136.
P. texasiana Moric., iii, 135.
tamaulipasensis Lea.
tridonia Beck.
P. triodontoides Bld., iii, 135.
P. behri Gabb., iii, 134.
P. ariadnæ Pfr., iii, 132.
couchiana Lea.
P. acutedentata W. G. B., iii, *loisa* W. G. B., iii, 134. [134.
quinquedentata F. & C.
v. unguifera Mouss., iii, 132.
P. anilis Gabb., iii, 130.
P. hippocrepis Pfr., iii, 134.

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P. johannis Poey, iii, 130. *notata* Poey.

Section *Triodopsis* Rafinesque.

Triodopsis plus *Mesodon* of authors.

Shell varying from depressed to globose-conoidal, umbilicate or imperforate; surface generally striated; whorls 5–6, the last wider, more or less deflexed in front. Aperture lunate, typically obstructed by three teeth, two on the lip, one on the parietal wall; but any or all of the teeth often absent. Type *P. tridentata* Say, pl. 30, fig. 8 (see also pl. 30, figs. 9, 10, *P. appressa;* pl. 30, figs. 13, 14, *P. albolabris* var. *maritima*; pl. 30, figs. 17, 18, *P. sayi*).

Jaw sculptured with numerous moderately spaced ribs (pl. 30, fig. 19, *P. sayi;* pl. 30, fig. 21, *P. kiawaensis*; pl. 21, fig. 11, *P. albolabris*).

Radula having (1) ectocones with cutting-points developed on central lateral and marginal teeth, as in *P. tridentata*, pl. 30, fig. 11, and *P. albolabris*, pl. 30, fig. 16, or (2) no side cusps or cutting-points whatever on any of the teeth, as in *P. clausa*, pl. 30, fig. 15.

Genital system as described for the genus (pl. 30, fig. 12, *P. inflecta*; pl. 30, fig. 20, *P. clausa*; pl. 21, figs. 12–16, *P. albolabris*). In *P. albolabris* Say (pl. 21, figs. 12–16) the lower third of the penis

(the portion everted during copulation) is smooth inside (fig. 15); it extends upward in a sort of sheath over the base of the upper portion (figs. 12, 15). This sheath is what Leidy and Binney call the "prepuce." The upper portion has fleshy walls which are densely corrugated or subgranulated within, and the cavity is almost filled by a thick longitudinal corrugated column, adnate throughout its length to one side (fig. 15, penis slit open longitudinally; fig. 13, 14, transverse sections of penis with fleshy column). At the apex of the cavity there is a perforated papilla (pl. 21, fig. 13, transverse section), free at its lower end. The retractor muscle is inserted on the vas deferens a short distance above the apex of penis; its distal end being attached to the floor of the lung cavity. The lower part of the spermatheca duct (pl. 21, fig. 15) is swollen, with fleshy walls which inside are strongly corrugated lengthwise (pl. 21, fig. 16, transverse section).

Distribution: Eastern North America from Canada to Florida, west to central Texas and Dakota; in the northwest occurring in Idaho, and on the Pacific slope from Sitka to Santa Cruz, California. Most of the species live around decaying logs or under and upon decaying leaves in forests. Some, like *multilineata* occur in great numbers on the low, weedy, willow covered flood-plains of rivers; others, like *profunda*, prefer shady, leaf-carpeted and rocky hillsides. *P. dentifera* and *P. palliata* are found under the loosened bark of hemlock boles, sharing these retreats with *Philomycus*. Most species come from their hiding-places in the warm days of early spring, and during rainy weather in summer. They may then be found crawling upon the dead leaves, or ascending nettles, etc., the leaves of which they eat. In sunny days after rain, they are found adhering to the lower surfaces of nettle leaves. They never ascend trees.

The species enumerated below have been divided by authors into two sections, *Triodopsis* and *Mesodon*; but such division seems to be artificial. Some species of *Triodopsis* are known to have varieties lacking lip-teeth, and these would technically fall into *Mesodon*. In other cases, such as the group of Idaho and Washington species, all the transitions from tridentate to toothless apertures occur. The group of *P. appressa* is also a transition group. Tryon has resuscitated the section-names *Xolotrema* and *Ulostoma*. The first of these is a Rafinesquian name totally unidentifiable; the second was proposed by Albers for species of *Polygyra s. s.* and *Triodopsis s. s.*, and

did not include either of the forms Tryon uses the name for! *Aplodon*, Raf., has also been used in this connection; it is positively unidentifiable.

Species.

P. tridentata Say, iii, 143.
lunula Raf.
v. juxtidens Pils.
v. edentilabris Pils.
P. fraudulenta Pils.
fallax auct., not Say, iii, 143.
P. fallax Say.
introferens Bld. iii, 145.
v. obsoleta Pils.
P. hopetonensis Shutt. iii, 144.
ephabus Say, ms.
P. vannostrandi Bld., iii, 145.
P. vultuosa Gld., iii, 144.
v. henriettæ Maz., iii, 144.
copei Weth., iii, 144.
v. cragini Call, iii, 144.

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P. rugeli Shuttlw., iii, 147.
P. inflecta Say, iii, 146.
P. edentata Samp., viii, 154.
edentula W. G. B.

* * *

P. mullani Bld., iii, 145.
v. hemphilli W. G. B., iii, 146.
binominata Tryon, iii, 146.
olneyæ Pils.
v. blandi Hemph.
v. harfordiana W. G. B., iii, [146.
commutanda Anc.
salmonensis Tryon, iii, 146.
v. oregonensis Hemph.
P. devia Gld., iii, 154.
baskervillei Pfr.
P. columbiana Lea, iii, 154.
v. labiosa Gld.
v. armigera Anc., viii, 155.
P. roperi Pils., viii, 154.
P. loricata Gld., iii, 145.
lecontii Lea.
P. levettei Bld., iii, 143.
thomsoniana Anc.
orobœna Anc.

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P. profunda Say, iii, 155.
richardi Fér.
? bulbina Dh.
P. sayii Binn., iii, 155.
diodonta Say, not Mühlf.
v. chilhoweënsis Lewis, iii, [155.
P. kiowaënsis Simp., viii, 155.
v. arkansaënsis Pils., viii, 156.
P. townsendiana Lea, iv, 72.
pedestris and *ruida*, Gld.
v. ptychophora A. D. Br., iii, [154.
f. castanea Hemph.

* * *

P. albolabris Say, iii, 150.
rufa DeK.
v. maritima Pils.
v. traversensis Leach.
v. major Binn., iii, 150.

P. andrewsi W. G. B., iii, 150.
P. exoleta Binn., iii. 151.
zaleta Binn., *olim.*
P. multilineata Say, iii, 150.
P. divesta Gld., iii, 152.
dejecta and *abjecta* Gld.
P. wetherbyi Bld., iii, 152.
P. roemeri Pfr., iii, 152.
P. dentifera Binn., iii, 152.

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P. appressa Say, iii, 148.
linguifera Lam.
v. perigrapta Pils.
P. sargentiana J. & P., viii, 153.
sargenti J. & P., not Bld.
P. subpalliata Pils.
P. obstricta Say, iii, 148.
helicoides Lea.
v. carolinensis Lea, viii, 153.
P. palliata Say, iii, 147.
denotata Fér.
notata Dh.

* * *

P. elevata Say, iii, 148.
tennesseensis Lea.
knoxvilliana Fér.
P. clarki Lea, iii, 149.
P. pennsylvanica Green, iii, 151.

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P. thyroides Say, iii, 152.
thyroidus Say.
v. bucculenta Gld., iii, 153.
P. clausa Say, iii, 153.
ingallsiana Shutt.
jugallsiana Alb.
P. wheatleyi Bld., iii, 151.
P. christyi Bld., iii, 151.
P. mitchelliana Lea, iii, 151.
P. downieana Bld., iii, 153.
P. lawi Lewis, iii, 153.
P. mobiliana Lea.
P. jejuna Say, iii, 153.

Section *Stenotrema* Rafinesque.

Shell small, *compact,* imperforate or umbilicate; subglobose, globose-depressed or lens-shaped the periphery varying from rounded to acutely keeled; *surface dull, smooth, generally hairy.* Whorls 5–6, *closely revolving,* the last suddenly deflexed in front. *Aperture basal, narrow, obstructed by an oblique blade-like parietal tooth parallel to the reflexed basal lip,* the latter often notched in the middle. Last whorl generally having in its last fourth a short transverse partition on the axis. Type *P. stenotrema* Fér. (see pl. 31, figs. 22, 23, 24, *P. monodon* var. *aliciæ*).

Animal externally as in *Triodopsis.*

Genital system having the penis notably longer than the receptaculum seminis and its duct, the latter being quite short (pl. 31, fig. 27, *P. spinosa*).

Jaw having the ribs wide and rather more crowded than is usual in the other sections of the genus (pl. 31, fig. 25. *P. monodon*).

Radula having ectocones developed on all the teeth; basal plates short and square, slightly shorter than the mesocones of central and lateral teeth; marginals with the basal plates short, wide, mesocone bluntly bifid at tip, ectocone simple or bluntly bifid (pl. 31, fig. 26, *P. hirsuta*).

Distribution: Entire Gulf and Atlantic drainages, north to Canada and south to southern Texas (San Antonio); Oregon. The species live under and around decaying logs and bits of wood.

This is a well-marked section, distinguished by the compact narrow-mouthed shell as well as the crowded, wide ribs of the jaw. The hairs of the shell collect a coat of earth, which renders the snails difficult to see, the dusky shade of the animal also assimilating their color to the surrounding earth or rotten wood. *P. monodon* ranges over nearly all of eastern North America; *P. hirsuta* has almost as wide a distribution; but the other species are rarer and more local; *P. maxillata, barbigera, edvardsi, edgariana, labrosa* and *spinosa* being confined to certain localities in the Cumberland system of mountains. *P. germana* is found in Oregon, but it may prove related to the *mullani* group of *Triodopsis*, rather than to *Stenotrema*.

Species of Stenotrema.

P. spinosa Lea, iii, 141.
P. labrosa Bld., iii, 141.
P. edgariana Lea, iii, 141.
P. edvardsi Bld., iii, 141.
P. barbigera Redf., iii, 142.
P. stenotrema Fér., iii, 140.
hirsuta var. a. Fér.
convexa Raf.
v. subglobosa Pils., viii, 152.
P. hirsuta Say, iii, 140.
? porcina Say.
v. altispira Pils.
P. maxillata Gld., iii, 141.
P. monodon Rack., iii, 142.
v. fraterna Say, iii, 142.
v. aliciæ Pils., viii, 152.
v. cincta Lewis, viii, 152.
P. leai Ward, iii, 142.
P. germana Gld., iii, 143.

Genus POLYGYRELLA Binney, 1863.

=*Polygyrella* Binn. & Bld.+*Ammonitella* Cooper.

Shell discoidal, openly umbilicated, the *spire slightly convex, flat, or concave; texture glassy*, somewhat translucent. Aperture sub-

triangular or crescentic, *the lip not in the least expanded*, blunt, *thickened within the edge* by a white rim, simple or two-toothed; parietal wall smooth or with an erect tooth. Type *P. polygyrella*, pl. 31, figs. 28, 29, 30.

External anatomy unknown. Genital system (in *P. polygyrella*, the only species yet investigated) *without accessory organs*, like that of *Polygyra* (pl. 31, fig. 31).

Jaw low and wide, with no median projection, having numerous strong vertical ribs, denticulating its margins (pl. 31, fig. 32).

Central teeth tricuspid, laterals bicuspid, marginal teeth bicuspid, the ectocone simple or bluntly bifid (pl. 31, fig. 41).

Distribution: California, Washington, Idaho and Montana.

The anatomy of the species of this genus is, as far as it is known, the same as in *Polygyra* except that the jaw is wider with more ribs. The shell differs from *Polygyra* in its absolutely unexpanded blunt lip and its glassy texture. It may be distinguished from the Palæarctic genus *Gonostoma* by the characters of the shell just mentioned (*Gonostoma* having an opaque shell with expanded or reflexed lip), and by the simplicity of the generative system. The relationship of *Polygyrella* to *Polygyratia* cannot be decided until the anatomy of the South American genus is made known.

[*Note.*—Mr. Binney's classified Synopsis of North American land shells, in which the name *Polygyrella* first appeared, is referred to as "a mere proof" by Professor Joseph Henry, Secretary of the Smithsonian Institution, who adds that it "should not be quoted as authority or referred to as a published work." This suggestion cannot be followed. The Synopsis is not in any ordinary sense a proof-sheet. A large edition of it was printed and widely circulated, as an official publication of the Smithsonian Institution.]

Subgenus Polygyrella Binney, 1863.

Polygyrella Binney, Smithsonian Miscellaneous Collections, no. 000, p. 5, Dec. 9, 1863 (no description; type *H. polygyrella*).—*Polygyrella* Bland, Binney & Bld., in Land and Fresh-Water Shells of North America, p. 112, type *H. polygyrella* Bld. & Coop. —W. G. Binney, Terr. Moll. v, p. 289 (jaw and dentition), and Second Supplement to the same, p. 36 (genitalia).—Pilsbry, Proc.

Acad. Nat. Sci. Phila. 1890, p. 300.—*Adelodonta* Ancey, Le Naturaliste, Dec., 1880, p. 334, type *H. polygyrella*.

Shell *disk-shaped*, the spire flat or nearly so, *periphery rounded, even in the young*; umbilicus wide within, showing all the whorls; *texture somewhat glassy* and subtranslucent, polished beneath; color yellow, greenish or light brown; whorls 6–8, narrow, slowly widening, the last slightly descending in front. Aperture subtriangular, oblique; *peristome blunt, not expanded, thickened within*, with or without lip-teeth or internal teeth; parietal wall bearing an erect triangular tooth. Type *P. polygyrella*, pl. 31, figs. 28, 29, 30, (see also pl. 31, figs. 33, 34, 35, *P. harfordiana*, enlarged).

Jaw very wide, arcuate, without median projection below; surface with numerous (17–36) broad, slightly separated ribs, denticulating either margin (pl. 31, fig. 32, *P. polygyrella*).

Radula long and narrow, with teeth according to the formula 22. 5.1.5.22. Teeth as in *Polygyra*, the centrals tricuspid the mesocone longer than the basal-plate; laterals bicuspid, marginals bicuspid, the ectocone bifid on the outer teeth (pl. 31, fig. 41, *P. polygyrella*).

Genital system like that of *Polygyra*, but having the duct of the spermatheca rather longer (pl. 31, fig. 31, *P. polygyrella*).

This group agrees with *Polygyra* in essential features of dentition, jaw and genitalia; it differs from that group in the glassy texture of the shell and its *totally unreflexed* lip. The texture of the shell is like *Systrophia*, but that South American type has the lip-edge slightly expanded.

P. polygyrella Bld. & Coop., iii, 129. Cœur d'Alêne Mts., Idaho.

P. harfordiana Coop. iii, 130. Fresno Co., California.

Subgenus Ammonitella Cooper, 1869.

Ammonitella J. G. Coop., Amer. Journ. of Conch. iv, p. 209. (Issued February 4, 1869).—*Gonostoma* W. G. Binney, Terr. Moll. v, p. 261.

Shell *Ammonite* shaped, with *sunken, concave spire*, and open umbilicus showing all the whorls; periphery broadly rounded; *texture glassy, subtranslucent*; whorls about 6, *very narrow and very closely revolving, the last whorl embracing the greater part of the preceding*, deflexed in front, its suture somewhat tangentially produced.

Aperture narrowly crescentic; lip blunt, thickened within except toward the upper termination, *not in the least expanded*, toothless; parietal wall toothless. Type *P. yatesi* Coop., pl. 20, figs. 32, 33, 34.

External characters and genitalia of animal unknown.

Jaw low, wide, slightly arcuate, without median projection below; surface with a strong transverse line of reinforcement, and about 12 wide crowded ribs, denticulating either margin (pl. 36, fig. 12, *P. yatesi*).

Radula long and narrow; teeth after the formula 18.6.1.6.18. Teeth like those of *Polygyrella*, but ectocone of marginals simple (pl. 36, fig. 11, *P. yatesi*).

This group has been united with the European genus *Gonostoma*, but erroneously. It is readily distinguished from that type by the non-expanded lip and glassy texture of the shell. The dentition also differs widely. The genital organs of *Gonostoma* present characteristic features, but as the soft anatomy of *Ammonitella* is unknown, no comparison can now be made. The American species will be found to have the genitalia simple, as in *Polygyrella*, if my estimate of its affinities proves to be correct.

P. yatesi Coop., iii, 115. Calaveras Co., California.
yatesiana W. G. B., *olim*.

Genus POLYGYRATIA Gray, 1847.

Polygyratia Gray, Proc. Zool. Soc. Lond., 1847, p. 173, type *H. polygyrata*.—*Ophiogyra* Albers, Die Hel. 1850, p. 91, type *H. polygyrata* Born.—*Systrophia* Pfr., Malak. Blätter, ii, 1855, p. 136, for *H. helicycloides, systrophia, heligmoidea*.—*Entodina* Ancey, Conchologists' Exch., i, p. 64, May, 1887, type *H. reyrei*.

Shell *disk-shaped*, flat or nearly so above, concave beneath, composed of 5–10 *narrow, closely coiled whorls, equally visible above and below*, the last descending in front. Aperture oblique, rounded or subtriangular, the lip generally narrowly expanded, sometimes toothed; parietal callus inconspicuous or raised into a tooth-like process. Type *H. polygyrata* Born, pl. 20, figs. 37, 38.

Animal unknown. The species are said to live in forests. The typical subgenus is confined to the central portions of South America. The affinities of the genus are problematical. It may perhaps prove to be allied to *Polygyrella*.

A number of forms agreeing with *Polygyratia* in general characters of the shell are found in Papua and New Ireland. Whether they have actual affinity to the South American types can be decided only by an examination of the soft parts. The excessively peculiar shell argues great antiquity for the group; and the somewhat similar distribution of Marsupials and Struthious birds suggests the theory of an ancient migration in the case of *Polygyratia*. Such a theory, however, rests on no known facts of palæontology or anatomy.

Subdivisions.

Subgenus I. Polygyratia Gray.

Shell having the whorls rounded at the periphery, the spire flat or concave. South American. Three sections, showing slight differences have been named:

Section *Polygyratia*. Last whorl provided with an internal barrier of short spiral lamellæ; parietal callus thin, appressed.

Section *Systrophia*. Last whorl without internal laminæ; parietal callus thin, appressed.

Section *Entodina*. Last whorl without internal laminæ; edge of parietal callus raised, connecting the ends of the lip, and forming a sort of parietal tooth.

Subgenus II. Coxia Ancey.

Shell having the whorls flat above, acutely keeled at the shoulder; spire subconcave, flat, or conical. Papuan region.

Subgenus I. Polygyratia Gray.

Section *Polygyratia* Gray (restricted).

Shell solid, typically with opaque dark coloring; lip expanded, its margin toothless; parietal callus thin, appressed, body-whorl having an internal barrier of short spiral lamellæ, on both outer and parietal walls. Type *P. polygyrata*, pl. 20, figs. 37, 38.

The internal lamellæ are like those of *Corilla*.

P. polygyrata Born, iii, 124.
charybdis Mörch.
P. quinquelirata Sm., viii, 150.
P. pollodonta d'Orb., iii, 126.

Section *Systrophia* Pfr., 1855.

Shell yellowish or corneous, thin, the lip slightly expanded, often having one or two teeth; *parietal callus slight, not elevated* nor toothed; *no internal lamellæ.* Type *P. helicycloides* d'Orb. (see pl. 20, figs. 41, 42, 43, *P. stenogyra*).

Distribution: Brazil, Bolivia, Equador, Peru.

P. calculina Pfr., iii, 125.
calculus Pfr. not Lowe.
P. decagyra Phil., iii, 125.
P. gyrella Morel., iii, 126.
P. helicycloides d'Orb., viii, 150.
P. ortoni Crosse, iii, 127.
P. polycycla Morel., iii, 125.
P. pseudoplanorbis Lub., iii, 126.
P. stenogyra Pfr., iii, 124.
P. stenostrepta Pfr.
P. systropha Alb., iii, 127.
P. tortilis Morel., iii, 125.
P. wallisiana Mouss., iii, 126.

Section *Entodina* Ancey.

Shell planorboid, many whorled; lip narrowly expanded, toothless or toothed, its ends connected across the parietal wall by an elevated, toothed callus. Type *P. reyrei* Souv., pl. 20, figs. 39, 40.

Distribution same as *Systrophia.*

The parietal callus is shaped somewhat like that of *Polygyra cereolus.*

P. cheilostropha d'Orb., iii, 128.
P. entodonta Pfr., iii, 126.
P. heligmoidea d'Orb., iii, 125.
P. janeirensis Pfr., viii, 150.
P. platygyra Alb.
P. reyrei Souv., iii, 127.

Subgenus? II. Coxia Ancey, 1887.

Coxia Anc., Conchologists' Exchange, i, p. 75, June, 1887. Type *Helix macgregori* Cox.—*Calostropha* Anc., Conch. Exch. ii, p. 38, Sept., 1887. Type *Helix raffrayi* T.-C.

Shell *many* (*about* 10) *whorled*, the volutions *acutely carinated at periphery* or shoulder, equally visible above and below. Spire either flat, slightly concave, or conoidal. Aperture oblique, subquadrangular, the lip expanded and slightly thickened, its ends connected by a parietal callus. Type *P. macgregori*, pl. 20, figs. 44, 45, 46.

Soft parts of animal unknown.

The shells in this group differ from those of the South American many-whorled Helices in the flat upper surface of each whorl, and its acute peripheral keel.

Helix multispirata Hombr. & Jacq. (Manual, iii, 127) and *H. microphis* Crosse, have been referred to *Polygyratia* by authors. The first is probably a *Charopa*. The other has been made the type of a group *Microphyura* by Ancey (Bull. Soc. Mal. Fr. v, 375). It belongs to the genus *Diplomphalus* in Rhytididæ (Manual i, p. 114).

Species.

P. macgregori Cox, iii, 127. New Ireland.
P. raffrayi Tap.-Can., iii, 128. Western New Guinea.

* * *

The series of genera next to be considered comprises a majority of the large, solid-shelled Helices of the tropics and southern hemisphere, both in the Old World and America. All discussion of this and other primary divisions of the Helices is reserved for the introductory portion of this volume, but certain brief notes may be of use in this place. These genera share certain peculiarities of the generative system: *the female branch is without dart sack or other accessory organs; the male side has the penis continued beyond its papilla-bearing apex in a narrow tube called the "epiphallus," which terminates in a flagellum and vas deferens.* In most forms the epiphallus is as long or longer than the penis itself; but in some (such as *Thelidomus*) it is so shortened as to be inconspicuous, or even absent. In *Cristigibba* this process of shortening has resulted in the complete degeneration of both epiphallus and flagellum. In these and similar cases we must not mistake the structure resulting from degeneration for a primitive condition. Such an error would be like holding *Ancylus* to be a primitive gastropod on account of its (at present) non-spiral shell, or like grouping the limbless lizards, *Anguis* or *Amphisbæna* with the snakes.

In the American forms the penis retractor is inserted upon the penis; in the Asiatic and Australian it is usually upon the epiphallus.

The jaw is generally stoutly ribbed, but often by degeneration of the ribs, smooth; and this modification is certainly in some cases not a generic or even subgeneric character.

Genus PLEURODONTE Fischer de Waldheim, 1808.

=*Pleurodonte* + *Lucerna* + *Dentellaria* + *Caracolus* + *Isomeria* + *Labyrinthus* + *Polydontes* + *Thelidomus* + *Liochila* + *Eurycratera*, etc., of authors.

Shell imperforate or umbilicate, rather large and solid, varying from globose-depressed to lens-shaped, the periphery rounded or keeled; surface striate or granular. Whorls 4 to 6. Aperture with or without teeth, the lip more or less expanded or reflexed. Eggs rather large, oval, hard-shelled, the newly hatched young having a shell of 2 to 2½ whorls. Type *P. sinuata* Müll. (See pl. 22, figs. 1 to 10; pl. 25, all figs except fig. 9.)

Animal having the sole undivided; lateral edges of foot with no traces of foot margin; tail rounded, convex above; sides of foot with granules arranged in oblique rows or irregular; back with some indistinct longitudinal lines or none; mantle-edge generally having small body lappets.

Jaw solid, arcuate, with blunt ends, and either smooth with a slight median projection, weakly ribbed, or with strong rounded ribs on its median moity (plates 21, 24, 26).

Teeth of radula in nearly straight transverse rows; central and lateral teeth unicuspid, the lateral expansions of the cutting point occupying the place of ectocones, or having side cutting points developed. Marginal teeth either unicuspid or having a bifid mesocone and a simple or bifid ectocone (plates 21, 24, 26).

Genitalia: Penis large, muscular, having *the retractor* and *epiphallus inserted at its apex;* interior with many longitudinal folds and usually a papilla; sometimes provided with a short appendix. Epiphallus varying from long to very short, *ending in a short flagellum. Female system lacking all accessory organs.*

Distribution, West Indies and northern South America. All of the species are ground snails.

The essential features of this genus are anatomical: (1) the insertion of the retractor on the penis itself; (2) the continuation of the penis in an epiphallus, into which the vas deferens enters, and which terminates in a flagellum; (3) the entire simplicity of the female system as in *Pyramidula* or *Polygyra;* (4) the rather large, hard shelled eggs; (5) the tendency of the teeth to develop mesocones at the expense of ectocones.

The jaw varies from the ribbed (odontognathous) to the smooth (oxygnathous) type. The shell exhibits a wide range of variation in the several sectional groups; but notwithstanding the considerable variations of both shell and soft parts, the genus is a well characterized one, the forms being unquestionably of common ancestry, al-

lied by a strong bond of affinity, and well distinguished from all other recent genera.

The genus stands isolated in the New World fauna, its relationships being decidedly with the groups of China, the East Indies, Papua and Australia. Its advent in Middle America is one of the most interesting problems in Helix distribution. The solution of this mystery is not lightened by the known distribution of Glandina, Clausilia, etc., in both the Old and the New Worlds, for no shells in the least allied to this genus of large Helices have been found in European tertiary strata.

A thorough study of the nomenclature of this group reveals the necessity of several unwelcome but apparently inevitable changes. The well known generic name *Caracolus*, must be replaced by *Pleurodonte*, which was proposed and defined in a perfectly proper and regular manner by Fischer de Waldheim. It is impossible to use the anonymous, undefined name *Lucerna*, of Humphrey's sale catalogue *Museum Calonnianum*, unless we disregard the universally recognized canons of nomenclature.

Subdivisions.

Pleurodonte may be divided primarily into two subgenera, each of which is split into several minor groups or sections. The latter are practically impossible to recognizably define in words, although not difficult to learn by sight. It will readily be understood, therefore, that no great importance attaches to these lesser groups. They are the natural result of late geological changes in the West Indies, which broke the parent stock into island colonies. The whole series tells clearly of a former period of greater elevation of the Antillean region, and closer connection with the middle American mainland. The fact that all of the main modifications are found upon the greater Antilles would lead us to believe that here the group first became established; that the Caribbees were peopled from the northwest, and the mainland of South America also from the north; and that the sections grouped below under subgenus *Polydontes* are a later modification of the stock, which took place subsequent to the migration to the southward. The full understanding of the distribution of these Helices, awaits the explanation by geologists of the main orographic changes of the West Indies during tertiary time—an inquiry beset with difficulty, and as yet but little understood.

Subgenus PLEURODONTE Fischer.

Shell generally solid, dark, depressed and opaque, the aperture generally toothed. Genitalia characterized by the long epiphallus, and lack of appendix on the penis.

Section 1, *Pleurodonte* (*sensu stricto*). Shell granulate, at least above; imperforate; aperture with compressed teeth on the basal lip only, or if not toothed the shell is not acutely keeled. Jamaica.

Section 2, *Caprinus* Montf. Shell solid, imperforate, with thickened peristome, sometimes armed with nodular teeth. Lesser Antilles.

Section 3, *Gonostomopsis* Pils. Shell thin, hirsute, umbilicate; aperture trilobate-lunar, outer and basal lips each with a tooth.

Section 4, *Caracolus* Montf. Shell large, solid, carinated; aperture lacking teeth. Cuba, Haiti, Porto Rico.

Section 5, *Isomeria* Alb. Shell depressed, large, dark, solid, not acutely keeled; aperture generally with small teeth. Ecuador, Columbia.

Section 6, *Labyrinthus* Beck. Shell carinated, depressed, with an entering parietal lamella and two processes on the basal lip.

Subgenus POLYDONTES Montf.

Shell depressed or globose, often light colored or variegated with many bands, the aperture generally toothless. Genitalia having the epiphallus very short or obsolete, and often with a swollen appendix near the base of the penis.

Section 7, *Thelidomus* Swains. Shell globose-depressed, baso-columellar lip of the peristome wide and plate-like, sometimes toothed; aperture otherwise lacking teeth.

Section 8, *Polydontes* Montf. Shell large, depressed, carinated; aperture toothless or with nodular teeth on the peristome; lip thick.

Section 9, *Parthena* Alb. Shell capacious, unicolored or multilineate. Aperture large, toothless; lip expanded.

Section 10, *Luquillia* Crosse. Shell similar, but dark colored, with conoidal spire.

Section 11, *Eurycratera* Beck. Shell large, globose, with few whorls. Aperture very large, toothless.

Section 1, *Pleurodonte* Fischer de Waldheim.

Pleurodonte F. de W., Tab. Synopt. Zoogn. p. 129 (Moscow, 1808); proposed for *H. sinuata* Gm., *lychnuchus* Gm., *lucerna* Gm.,

inæqualis Fisch., *lapicida* L., *isognomostomos* Gm.—*Pleurodonta* Beck, Index Molluscorum p. 33, and of subsequent authors.—*Dentellaria* Schumacher, Essai d'un Nouv. Syst. des Hab. des Vers Test., p. 69, 230, proposed for *D. globularis* Schum. (undescribed and unfigured) and *D. sinuata* Mull. (1817).—*Lucerna* "Humph." Swains., Malacology, p. 329 (in part).—Man. of Conch. v. p. 97.—Not *Lucerna* Humphrey, Museum Callonianum p. 61, 1797.

Shell imperforate or umbilicated, solid, opaque, varying from subglobose to lens-shaped; surface densely granulated, at least above. Whorls 4½–6, the last deflexed in front. Aperture wider than high; peristome broadly expanded, toothless or having from one to five teeth upon the basal lip; parietal wall calloused but without teeth. Type *P. sinuata* Müll. (See pl. 25, figs. 6, 7, *P. sloaneana var. vendryesi;* pl. 25, fig. 8, *P. acuta var nobilis.*)

Animal having the sole undivided, foot edge with no trace of border; tail rounded behind; back with a few indistinct grooves from mantle to head, the sides irregularly granulated.

Genital organs as in *Caprinus.* Penis stout, cylindrical, the retractor muscle and epiphallus inserted at its apex; epiphallus long, flagellum short. Spermatheca oval, situated on a long duct (pl. 24, fig. 5, *P. invalida;* pl. 24, fig. 6, *P. acuta*).

Jaw arcuate, solid, having unequal, strong, rounded ribs denticulating both margins, the ends blunt and free from ribs (pl. 24, fig. 4, *P. acuta*).

Dentition as in *Caprinus.* Central and lateral teeth having the mesocones large and long, expanded laterally. Marginal teeth having an oblique cusp, formed by the united ento-, meso- and ectocones, which are indicated by slight notches (pl. 24, fig. 7, *P. acuta*). Distribution, Jamaica.

Pleurodonte is allied to *Caprinus* in characters of dentition and genitalia, the anatomical features of the two groups being practically alike. The shell differs from that of *Caprinus* somewhat in the arrangement of the teeth, which in *Pleurodonte* are restricted to the basal lip; but chiefly by the general *facies*—something difficult to define, but readily recognized in the shells themselves. The group is developed with a wonderful exuberance and variety of specific and subspecific forms, perhaps unparalleled in any tract of like extent in the world. The anatomy has been investigated by Semper (Reisen), Binney (Ann. N. Y. Acad.), and myself.

This group has hitherto been called *Pleurodonta* or *Lucerna;* but Fischer's Latin form of the word, as well as his French version, was "*Pleurodonte.*" His name was accompanied by a sufficient diagnosis. He included several species of the Jamaica group, and also *H. lychnuchus, lapicida* and *isognomostomus* (=*personata*); but as these three have been made the types of subsequent groups, we obtain by elimination a residue of several congruous species, of which the first one of his list has been selected as the type. *Dentellaria* Schumacher was proposed for two species, the first one of which was undescribed and unfigured, but compared with an old illustration probably representing a small form of *H. acuta*; the second being *H. sinuata* Müll. *Lucerna*, proposed anonymously by Humphrey in the sale catalogue of M. de Callonne's collection, was not defined, and contains none of the Jamaica group, so far as one may judge by the fantastic list of species given under impromptu names of the auctioneer's manufacture. He seems to have included *Labyrinthus, Anostoma* and *Phania* among other shells; but the work is not worthy of quotation in scientific literature, and its introduction therein by the Adams brothers has caused nothing but confusion.

Species.

P. carmelita Fér., v, 99.
mora Gray.
redfieldiana C. B. Ad.
P. bainbridgei Pfr., v, 99.
lamarckii v. unidentata Fér.
v. pretiosa C. B. Ad., v, 100.
v. splengleriana Pfr., v, 100.
P. subacuta Pfr., v, 100.
P. acuta Lam., v, 100.
v. acuta Lam., v, 100.
acutissima Lam.
heteroclites Lam.
v. lamarckii Fér., v, 102.
v. sublucerna Pils., v, 102.
v. patina C. B. Ad., v, 102.
f. goniasmos A. D. Br., v, 102.
f. nannodonta A. D. Br., v, 103.
v. oxytenes A. D. Brown, v, 103.
v. ingens C. B. Ad., v, 103.
v. nobilis C. B. Ad., v, 103.
P. abnormis Pfr., v, 104.
P. chemnitziana Pfr., v, 104.
fluctuata C. B. Ad.
P. lucerna Müll., v, 105.
v. julia Fér., v, 105.
v. fuscolabris C. B. Ad., v, 106.
P. rhynchæna A. D. Br., v, 106.
P. peracutissima C. B. Ad., v, 106.
straminea Alb.
martiniana Pfr.
P. cara C. B. Ad., v, 107.
amabilis C. B. Ad.
v. media Ad., v, 107.
P. soror Fér., v, 107.
quadridentata Mke.
P. schrœteriana Pfr., v, 108.
v. chittyana C. B. Ad., v, 108.

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P. tridentina Fér., v, 109.
swainsoniana C. B. Ad., v, 109.
v. browneana Pfr., v, 109.
v. subsloaneana Pils., v, 110.
P. okeniana Pfr., v, 110.
fortis C. B. Ad., Rv.
P. atavus Shuttl., v, 110.
P. sloaneana Shuttl., v, 111.
bronni v. β Pfr.
schrœteriana Rv.
v. vendryesi Ckll., viii, 263.
P. bronni Pfr., v, 112.
P. strangulata C. B. Ad., v, 112.
P. valida C. B. Ad., v, 113.
P. picturata C. B. Ad., v, 113.
sinuata Deless., Chenu, etc.
P. pallescens Shuttl., v, 114.
P. sinuata Müll., v, 114.
v. propenuda Ad., v, 115.
P. sinuosa Fér., v, 115.
consanguinea C. B. Ad.
v. simson Pfr., v, 116.
P. invalida C. B. Ad., v, 117.
v. candescens C. B. Ad., v, 117.
P. anomala Pfr., v, 117.

Section *Caprinus* Montfort, 1810.

Caprinus Montf., Conch. Syst., ii, p. 142, type *Caprinus recognitus* Montf. (=*H. lychnuchus* Müll.).—*Lucidula* Swains., Treatise on Malacol., p. 329, type *barbadensis* (=*isabella* Fér.).—*Lucernella* Swains., *t. c.*, p. 330, type *hippocastaneum* (=*nuxdenticulata*).—*Dentellaria* Beck, Index Molluscorum p. 34, (1837), and of subsequent authors. Not *Dentellaria* Schumacher, Essai, p. 230!

Shell imperforate, *solid, opaque,* globose or depressed, the spire convex or conoidal, periphery rounded or keeled. Surface generally granulated. Aperture transverse, wider than high, oblique, the *peristome thick,* expanded, the *basal lip widened and generally toothed*; parietal wall covered with a callus, sometimes toothed. Type see also (*P. lychnuchus P. isabella* Fér., pl. 25, fig. 11; pl. 25, fig. 10, *P. nuxdenticulata*).

Animal (of *P. orbiculata*) having the sole undivided; edges of foot with no trace of a foot-margin. Entire upper surface rather evenly granulated, the granules arranged in rather indistinct longitudinal rows on the back, elsewhere irregularly placed. Mantle margin without shell-lappets, the right body-lappet well developed, the left minute, subobsolete.

Jaw arcuate, solid, and either having few strong ribs (*pachygastra, orbiculata, isabella, dentiens, nucleola, badia, nuxdenticulata*), or without ribs, but having a median projection (*formosa, josephinæ*). *P. orbiculata, perplexa* and *lychnuchus* have weak ribs or traces of ribs, thus connecting the two extremes of jaw structure (pl. 24, fig. 2, *P. josephinæ*; fig. 3, *nuxdenticulata*; fig. 9, *orbiculata*; fig. 11, *dentiens*).

Dentition characterized by the absence of side cusps on central and lateral teeth, a lateral continuation of the reflexed cutting edge of the mesocones representing the absent side cutting points. Marginal teeth having a large, bifid mesocone and a small simple or bifid ectocone (pl. 24, fig. 8, *P. orbiculata*; pl. 24, fig. 12. *P. dentiens*).

Genitalia without accessory organs on the female side, the duct of the spermatheca long. Penis having the retractor muscle inserted at its apex, and continued above in a long epiphallus terminating in a flagellum (pl. 24, fig. 10, *P. orbiculata*).

Distribution, Lesser Antilles.

In this group the shell is solid and opaque, as in *Caracolus* s. str., but the basal lip is widened and more or less distinctly toothed. It is closely allied to the *Pleurodonte* series, of Jamaica; and while it is easy to distinguish the two groups on sight, it is extremely difficult to point out the differences in words. Anatomically *Caprinus* and *Pleurodonte* are similar.

It is much to be regretted that the well-known name for this section had to be rejected; but it is better to correct the mistakes of early systematists than to perpetuate them.

P. nuxdenticulata Chemn., v, 82.
punctata Born not Müll.
hippocastaneum Lam.
P. nucleola Rang, v, 82.
crassidens Pfr.
P. parilis Fér., v, 83.
pseudoparilis Grat.
P. obesa Beck, v, 83.
P. dentiens Fér., v, 84.
v. isabellina Pils., v, 85.
P. isabella Fér., v, 85.
barbadensis Lm.
guildingi Pfr.
P. orbiculata Fér., v, 86.
P. badia Fér., v, 86.
v. guadeloupensis Pils., v, 87.
P. lychnuchus Müll., v, 87.
recognitus Montf.
P. josephinæ Fér., v, 88.
scabrella Mke.
v. nevisensis Pils., v, 89.
P. perplexa Fér., v, 89.
granifera Gray.
P. formosa Fér., v, 90.
lenocinia Fér.
P. pachygastra Gray, v, 90.
fuscoviridis Grat.
dolata Fér.
P. nigrescens Wood, v, 91.
fuliginea Fér.

Section *Gonostomopsis* Pilsbry, 1889.

Gonostomopsis Pils., Man. Conch. v, p. 92.—*Chrysodon* Anc., Conchol. Exch. i, p. 54, 1887, not *Chrysodon* Oken, 1815.

Shell narrowly umbilicated, rather thin, opaque, *hirsute, the spire depressed*, body-whorl depressed, rounded at periphery. Aperture as high as wide, *trilobate-lunar*; peristome narrowly expanded, the outer and basal margins each with one tooth. Type *P. auridens* Rang, pl. 25, figs. 12, 13.

Anatomy unknown. The single species inhabits Martinique. It resembles in form *H. obvoluta* Müll. of Europe.

Section *Caracolus* Montf.

Caracolus Montf., Conch. Syst. ii, p. 138.—Pilsbry, Man. of Conch. v, p. 118.—*Caracolla* Schum., Essai, p. 192, 1817.—*Serpentulus* (Klein, Tent. Meth. Ostr., p. 8, 1753; in part) H. & A. Ad., Gen. Rec. Moll. ii, p. 201.—*Lampadion* Bolt. in part.—*Discodoma* Swains., Malacol., p. 329, 1840.

Shell depressed, *carinated*, imperforate or umbilicate; thick, *solid and opaque*; *spire conical*, apex obtuse. Whorls 5-6, the last but little or not deflexed in front. Aperture oblique, wider than high; *peristome not toothed*, its basal margin expanded or narrowly reflexed, terminations remote. Type *P. caracolla* L., pl. 25, fig. 1.

Jaw arcuate, stout, and either smooth with a low median projection (*P. caracolla, P. marginella, P. semiaperta*), or furnished with stout ribs (*P. bornii*). See pl. 26, fig. 3, *P. marginella*; pl. 26, fig. 6, *P. marginella* var. *rostrata*.

Radula having the central and lateral teeth furnished with a single broad obtuse cusp (coalescent meso- and ectocone). Marginal teeth having an oblique cusp, which is simple as in the lateral teeth, or split into mesocone and ectocone (pl. 26, fig. 8, *P. caracolla;* fig. 1, *P. maginella*; fig. 2, *P. marginella var. semiaperta*).

Genital organs having the vagina more or less swollen, spermatheca oval, on a rather long (*P. caracolla*) or a short duct (*P. marginella*). Penis long, the retractor inserted at its summit; continued in a long epiphallus which terminates in a short flagellum (pl. 26, fig. 7, *P. caracolla*, penis everted; pl. 26, figs. 4, 5, *P. marginella var. rostrata* viewed from both sides, the extremely short flagellum seen in fig. 4).

Distribution: Eastern Cuba (*P. marginella* and varieties), Hayti (*P. caracolla, excellens, insititia, sarcocheila, angistoma, bizonalis* and *semiaperta*), and Porto Rico and Viéque (*P. bornii*).

The strong, opaque, carinated shell, with toothless aperture, unicolored or with few, broad bands, is characteristic, as is also the very long epiphallus and short flagellum, and the blunt, broad cusps of the teeth. The jaw is either smooth or ribbed, as in *Caprinus*. A fuller knowledge of the genitalia is necessary for the final settlement of specific limits; meantime the following arrangement is offered.

P. caracolla Linn., v, 120.
tornata Born.
albilabris Lam.
oculatus Montf.
P. excellens Pfr., v, 120.
P. insititia Shutt., v, 121.
P. sarcocheila Mörch, v, 121.
P. angistoma Fér.
angystoma Dh.
anchistoma v. Mart.
P. bornii Pfr., v, 127.
marginella Pfr not Gmel.
P. bizonalis Desh., v, 127.
v. gaskoini Pfr. v, 127.
P. marginella Gmel., v, 124.
marginata Born.
sagemon Beck.
arangiana Poey.
marginatoides d'Orb.
? fasciata Blv.
? indiscreta Beck.
v. gutierrezi Poey, v, 125.
v. schwartziana Pfr., v, 125.
v. mina Pfr., v, 125.
marginata Orb.
jactata Gundl.
v. rostrata Pfr., v, 126.
pazensis Poey.
cupulata Pfr.
v. marginelloides d'Orb., v, 126.
transitoria Pfr.
v. semiaperta v. Mart., v, 125.

Section *Isomeria* Albers, 1850.

Isomeria Alb., Die Hel., p. 126, type *H. oreas* Koch.—v. Mart., Die Hel., p. 155.—Pilsbry, Manual of Conch. v, p. 135.

Shell depressed, *solid, opaque, chestnut or chocolate colored*, rounded or obtusely carinated at the periphery, imperforate or umbilicated. Spire depressed, convex, with 6 or fewer whorls, the last deflexed or straight in front. Aperture wider than high, very oblique; peristome expanded or reflexed, toothless or with small teeth, of which one is situated near the termination of the periphery; ends of peristome remote, joined by a parietal callus, the parietal wall often having an oblique tooth. Type *P. oreas* Koch. (pl. 25, figs. 2, 3, *P. faunus var. ritchieana*).

Animal unknown.

A group of large and beautiful dark colored helices confined to the valleys of the higher Andes of Ecuador and Columbia, where

they replace *Labyrinthus* of the lower regions of northern South America. The shells differ from *Labyrinthus* in the more or less transversely dilated contour, the swollen base of the latter portion of the body-whorl, and the less developed aperture-teeth. In a few species (*ænigma, vexans*) the teeth are strongly developed; but these are to be regarded as an independent line of evolution from typical *Isomeria*, rather than as an intermediate or ancestral form between *Isomeria* and *Labyrinthus*.

Species.

P. oreas Koch, v, 136.
procera Pfr.
P. faunus Phil., v, 137.
v. ritchieana Pils., v, 138.
P. subelliptica Mouss., v, 139.
P. continua Pfr., v, 137.
P. aloagana Jouss., v, 139.
P. peritropis Pils., v, 140.
P. fordiana Pils., v, 141.
P. calomorpha Jonas, v, 142.
P. æquatoriana Hid., v, 142.
P. scalena v. Mart., v. 143.
P. meobambensis Pfr., v, 144.
P. atrata Pfr., v, 144.
P. mauritii Jouss., v, 145.
atrata Rv. not Pfr.
P. cymatodes Pfr., v, 146.
P. parietidentata Mill., v, 147.
P. kohlbergi Mill., v, 148.
P. martinii Bern., v, 149.
morula Hid.
P. granulatissima Mill., v, 148.
P. gealei E. A. Sm., v, 149.
P. stoltzmanni Lub., v, 150.
P. æquatoria Pfr., v, 150.
P. equestrata Moric., v, 151.
P. triodonta d'Orb., v, 152.
P. juno Pfr., v, 152.
P. neogranadensis Pfr., v, 153.
P. hartwegi Pfr., v, 153.
loxensis Mill.
P. basidens Mouss., v, 154.
P. bituberculata Pfr., v, 154.
bourcieri Rv. not Pfr.
v. tridentula Mill., v, 155.
v. latidentata Mill., v, 156.
P. bourcieri Pfr., v, 156.
bituberculata Rv. not Pfr.
P. subcastanea Pfr., v, 157.
globosa Brod. not Sowb.
P. ænigma Dohrn, v, 158.
P. vexans Dohrn, v, 158.

Section *Labyrinthus* Beck, 1837.

Labyrinthus Beck, Index Moll., p. 33, type *L. otis=labyrinthus* Dh.—Pilsbry, Manual of Conch. (2), v, p. 159.—Martens, Biol. Centr. Amer., Land Moll., p. 175.—*Lyrostoma* Swains., Malacol. p. 329, type *L. labyrintha.*—*Lyriostoma* Swains., *l. c.*, footnote (1840).

Shell umbilicate, depressed, carinated, microscopically granulated, not transversely dilated. Whorls less than 6, the last descending in

front, constricted behind the peristome. Aperture transverse, subhorizontal, *obstructed by three primary folds or teeth,—one long parietal fold, one tooth on the outer, another on the inner portion of the basal lip;* peristome expanded or reflexed in every part, *continuous across the parietal wall.* Type *P. labyrinthus*, pl. 25, figs. 4, 5. (See also pl. 22, figs. 7, 8, *P. sieversi*).

Soft parts unknown. Jaw slightly striated (Mörch, Journ. de Conch. 1865, p. 381), with a slight median projection. Teeth all uni-cuspid (Semper, Reisen, p. 105) as in the Cuban *Caracolus.* (Pl. 26, fig. 9, *P. plicata* Born, after Semper).

This group is characteristic of northern South America, extending from the Amazon River and its western tributaries in eastern Peru, northward in Central America to Costa Rica. It inhabits less elevated regions than the allied group *Isomeria.* Its complicated aperture-armature has doubtless been evolved for protection against predaceous insects (*cf.* Man. of Conch. v, p. 159; Biol. Centr. Amer. Moll., p. 175; Pop. Sc. Monthly, 1892, p. 191).

Labyrinthus agrees with the restricted section *Caracolus* in teeth and jaw, as well as in the general features of the shell. It stands in about the same relation to *Caracolus* that *Triodopsis* and the auriculate Polygyras hold toward the toothless Mesodons. There seems no sufficient reason for considering *Labyrinthus* a distinct genus, as von Martens has done.

Species.

P. labyrinthus (Chem.) Dh. v, [161.
subplanata Petit.
v. erecta Mouss., v, 162.
v. sipunculata Forbes, v, 162.
annulifera Pfr.
P. plicata Born, v, 163.
hydiana Lea.
hydeanus v. Mart.
P. uncigera Petit, v, 164.
conoidea Anc., viii, 264.
anopla Anc., viii, 264.
v. creveauxiana Anc., viii, 264.
P. triplicata v. Mart., v, 165.
æsopus Ang.
P. leucodon Pfr., v, 167.
P. sieversi v. Mart., viii, 263.
P. quadridentata Brod., v, 168.
P. tamsiana Dkr., v, 169.
P. tarapotonensis Moric., v, 170.
P. bifurcata Desh., v, 170.
P. furcillata Hupé, v, 171.
P. raimondii Phil., v, 172.
P. yatesi Pfr., v, 173.
P. ellipsostoma Pfr., v, 173.
P. leprieurii Petit, v, 174.
auriculina Petit.
P. dunkeri Pfr., v, 174.
P. isodon Pfr., v, 175.

P. manueli Higg., v, 166.
manoeli Pfr.
manseli Pfr.-Cless.

P. bogotensis Pfr., v, 176.
P. otostoma Pfr., v, 176.
stostoma Rv.

Section *Thelidomus* Swainson, 1840.

Thelidomus Swains., Malacology, p. 191, 192, 330, type *H. incerta* Fér. Not *Thelidomus* Swains., *t. c.*, p. 228, 353,=larva-cases of *Helicopsyche*, (Neuroptera).— *Otala* Beck and others, not of Schumacher. —*Pachystoma* Albers, Die Hel., 1850, p. 125. Not *Pachystoma* Guilding, Zool. Journ. 1828, p. 536.—*? Thelidonta* Swains, *t. c.*, p. 194.

Shell imperforate, globose-depressed, with few whorls, the last deflexed in front, swollen beneath, carinated or rounded at the periphery. Surface granulated, costulate-striate or decussated. Aperture very oblique; peristome expanded, thickened within, the lower margin straightened, with a plate-like callus inside. Type *P. incerta* Fér. (See pl. 22, fig. 5, *P. lima*; pl. 22, fig. 4, *P. trinitaria*).

Jaw arcuate, having 7–15 strong ribs, sometimes not denticulating the lower margin (pl. 23, fig. 23, *P. auricoma var. havanensis*).

Radula either with or without ectocones on central and inner lateral teeth. Marginal teeth obtusely and obscurely bicuspid. Pl. 23, fig. 22, *P. auricoma* var. *havanensis.*

Animal having the sole undivided; lateral edges without trace of pedal grooves or margins. Sides of foot granulated, granules arranged in vertical series in the middle, obliquely descending series in front and behind; back irregularly granular, without longitudinal grooves.

Genital system having the penis stout, with a flagellum at apex; vas deferens and retractor muscle also inserted at apex, the latter slender, and attached distally to the integument of the vestibule; a small appendix sometimes present; no internal papilla, the opening of the vas deferens being a simple orifice at the base of the flagellum (pl. 23, fig. 19, showing opened penis and vestibule). Spermatheca oval or oblong, enveloped in the folds of the uterus, its duct short, bearing at the base a broad muscle connecting with the integument of the body-wall near the genital orifice (pl. 23, fig. 21, *v. m.*); ovotestis composed of one compact tuft of long cæca, (pl. 23, figs. 19–21, *P. auricoma* var. *havanensis*; pl. 23, fig. 24, *P. lima*; pl. 23, fig. 25, *P. aspera*).

The principal peculiarity of the shell of *Thelidomus* is the plate-like baso-columellar lip, somewhat like that of *Acavus* or *Macularia*. The anatomy exhibits considerable variation in some details, such as the presence (pl. 23, fig. 24, *lima*) or absence (pl. 23, figs. 20–21, *auricoma* v. *havanensis*) of an appendix. The spermatheca duct is much shorter than in *Parthena*. Many more species must be investigated before a satisfactory account can be given of the peculiarities of the genitalia of *Thelidomus* and related groups. See Poey, Memorias; W. G. Binney, Proc. Acad. Nat. Sci. Phila. 1875, and Ann. N. Y. Acad.; Semper, Reisen, pl. 15. The eggs are oval, white and calcareous-shelled; the embryonic shell is densely granulated in the typical forms, shining and radially grooved in the Cuban group which I have called *Zachrysia*. The latter are said to form a calcareous epiphragm.

(*Thelidomus s. str., species of Jamaica, Porto Rico and Lesser Antilles*).

P. incerta Fér., v, 57.
notabilis Fér.
curvidens Pfr.
striolata Guild.
alutacea Zgl.
velutinoides Anton.
ravnii Beck.
P. lima Fér., v, 58.
punctifera Lm.
asperula Beck.
v. castrensis Pfr., v, 59.
P. aspera Fér., v, 59.
granosa Wood.
P. cognata Fér., v, 59.
P. discolor Fér., v, 60.
P. ? sanctæluciæ Smith, v, 198.

(*Zachrysia*; *species of Cuba and Bahamas*).

P. petitiana Orb., v, 60.
P. guanensis Poey, v, 61.
P. scabrosa Poey, v, 61.
P. auricoma Fér., v, 62.
microstoma Lm.
v. noscibilis Fér., v, 63.
v. havanensis Pils.
"*zeta* Pfr." v, 63.
v. provisoria Pfr., v, 63.
P. emarginata Gundl., v, 64.
P. bayamensis Pfr., v, 64.
P. guantanamensis Poey, v, 65.
v. proboscidea Pfr., v, 66.
P. rangelina Pfr., v, 66.
P. trinitaria Gundl., v, 67.
P. baracoensis (Gut.) Poey, v, [67.
lamellicosta Pfr.

Section *Polydontes* Montfort.

Polydontes Montf., Conch. Syst. ii, p. 154, type *P. imperator*.

Shell large, depressed, imperforate or narrowly umbilicated, *solid and heavy*; the surface microscopically decussated. Whorls 4½–5,

the last often carinated, slightly deflexed in front. Aperture oblique, *the peristome thick*, expanded, simple or bearing obtuse teeth, and *having an obtuse fold near the columellar insertion*. Type *P. imperator*, pl. 22, fig. 9.

Anatomy unknown. Eggs large, oblong, with a hard calcareous shell, that of *P. imperator* (pl. 22, fig. 10) measuring 8½ by 12 mill. Young having when hatched a granulated, umbilicated shell of about 2½ whorls, measuring about one-fifth the diameter of the adult shell.

The shell in this section is generally marked with many spiral lines of brown, the widest and most conspicious being immediately below the periphery. *P. apollo* is sometimes unicolored. It will be seen that in coloration, the relationship of *Polydontes* to *Parthena* (*P. dominicensis*, etc.) is extremely close. All three species of *Polydontes* are known to voluntarily amputate their tails when captured (Journ. de Conchyl. 1860, p. 226). They live under dead leaves. Distribution, eastern Cuba.

P. imperator Montf., v, 79.
magica Fér.
P. apollo Pfr., v, 79.
P. sobrina Fér., v. 80.
crassilabris Pfr.

Section *Parthena* Albers.

Parthena Alb., Die Hel., p. 112 (first species *H. angulata*).

Shell imperforate, globose or depressed, the periphery rounded or carinated; spire short, whorls 4–4½, the earlier 1¾ forming a granulated or radially grooved embryonic shell, the last notably inflated and capacious, unicolored or begirt with many brown lines; surface granulated. Aperture large; peristome expanded; columella arcuate. Type *P. angulata*, pl. 22, fig. 2. (See also pl. 22, fig. 3, *P. dominicensis*).

Animal (of *P. dilatata*) having the sole undivided, with no indication of lateral borders or pedal grooves. Upper surface and sides coarsely granulated, the granules arranged in descending rows on the sides, finer and irregular on the back; tail rounded above; back from mantle to face irregularly granulated, lacking longitudinal grooves. Mantle-edge lacking shell-lappets; body-lappets well developed, the right one short, the left extending the entire length of the outer lip of the shell (pl. 23, fig. 15, showing posterior angle of aperture, respiratory opening and lappets).

Jaw strong, arcuate, sculptured with high, rather narrow ribs crenulating the upper margin only, or both margins (pl. 23, fig. 16, *P. dilatata*). In *P. angulata* Binney found 7 ribs on the jaw; in *crispata* 10 ribs. In *P. dilatata* we find 9–11 ribs, which crenulate the upper but not the lower margin, the latter having a slight median projection.

Dentition: Central and lateral teeth having stout, long mesocones projecting beyond the basal-plates; ectocones represented by a lateral bulging of the reflection of the cusp, or by distinctly developed cutting-points. Marginal teeth having the mesocones stout, oblique, blunt or sub-bifid, the ectocone simple, minute (pl. 23, fig. 18, *P. angulata*; pl. 23, fig. 17, *P. dilatata*).

Genitalia: Female system presenting no accessory organs; the spermatheca short, globular, situated upon a long duct. Penis stout, cylindrical, having a large globular appendix near its base. At its apex is situated a short, curved, obtuse flagellum, near the base of which is inserted the vas deferens, and a short teat-like organ which is solid and fleshy, not perforated or hollow. No retractor muscle seen. When opened lengthwise the walls of the cavity of the appendix and of the penis are seen to be longitudinally folded (fig. 14), the folds disappearing in the upper part of the penis-cavity. The upper part of the cavity is occupied by a large, free, pestle-shaped penis-papilla, perforated at the end, the perforation leading to the cavity of the vas deferens and flagellum the latter being corrugated inside (pl. 23, fig. 13, 14, *P. dilatata*).

Distribution: Hayti.

P. angulata Fér., v, 69.
inflata Dh.
acutangula Beck.
P. obliterata Fér., v, 69.
P. angustata Fér., v, 70.
P. dominicensis Pfr., v, 70.
extensa Pfr. not Müll.
P. dissita Dh., v, 71.
P. undulata Fér., v, 72.
lineolata Lam.
v. crispata Fér., v, 72.
P. dilatata Pfr., v, 73.

Section *Luquillia* Crosse, 1892.

Luquillia Crosse, Journ. de Conchyl. 1892, p. 19, type *H. luquillensis*.—*Leiostoma* Swains. Malacol., p. 328 (preoc.), 1840.

Shell imperforate, solid, subglobose with rather conoidal spire, of about 5½ whorls, the earliest 2½ forming the *large, coarsely gran-*

ulated embryonal shell, the following whorls *microscopically decussated*; the last whorl rounded at periphery. Color yellowish-brown *with dark oblique streaks* and sometimes a subperipheral girdle. Aperture wider than high, the thick lip expanded; columella short, arcuate, with an obscure callus fold. Type *P. luquillensis* Shutt. (See pl. 22, fig. 1, *P. gigantea*).

Soft anatomy and jaw unknown. Radula (of *P. luquillensis*) as in *Parthena angulata*, q. v.

Distribution, Haiti and Porto Rico.

P. gigantea Scop., v, 73.
cornumilitare auct. not L.
P. audebardi Pfr., v, 74.
P. luquillensis Shutt., v, 74.

Section *Eurycratera* (Beck) Gray.

Eurycratera BECK, Index Moll., p. 45, in part.—GRAY, P. Z. S. 1847, p. 171, type *H. jamaicensis.*—*Lejocheila* or *Leiocheila* ALBERS, Die Hel., p. 109, 1850.—*Liochila* v. MART., Die Hel., p. 146, 1860, type *H. jamaicensis.*

Shell imperforate, *globose*, solid, the surface finely wrinkled, embryonal whorls 1½, large, shining, not granulated. Whorls 4, *the last very large*, rounded, having few color bands. *Aperture very large*, oval, the outer lip expanded, columella long, arcuate; parietal and columellar callus spreading upon the base. Type *P. jamaicensis* Gmel., pl. 22, fig. 6.

Jaw thick, arcuate, attenuated toward the ends, the anterior surface sculptured with 14 decided but unequal ribs, irregularly disposed, and denticulating either margin. Lingual membrane with 41.1.41 teeth. Side cusps and cutting points wanting on central and inner lateral teeth, but represented by an expansion of the reflexed sides of the mesocones. The single species is confined to Jamaica.

Beck selected no type for *Eurycratera*, and his list of species includes forms belonging to many diverse groups. Gray, in 1847 selected *H. jamaicensis* as type of the group, and I do not see how we can avoid following his selection; especially in view of the fact that v. Martens, in 1860, selects as type *H. dominicensis*, a species not included by Beck in his list, and therefore certainly not the type of his group.

Genus CAMÆNA (Alb.) Pils. & v. Möll.

Camœna Albers, Die Heliceen p. 85, 1850, in part.—*Camena* Alb., v. Martens, Die Hel. 2d. edit., p. 165, type *cicatricosa* Müll. (restricted to sinistral species of Camæna and Euhadra).—*Camœna* Alb., Pilsbry, Man. of Conch. vi, p. 197, and viii, 265.—v. Moellendorff, Nachrichtsbl. d. D. M. Gesellsch. 1891, p. 195.—Pilsbry, *l. c.*, 1892, p. 71 ; Proc. Acad. Nat. Sci. Phila., 1892, p. 398 (anatomy).—*Eucochlias* Theob. in Nevill's Handlist Moll. Ind. Mus. pt. 1, p. 81, 1878 (type, *ochthoplax;* contains also *bougainvillei, illustris sulcocincta* and *pyrostoma*).

+*Pseudobba* v. Moell. and *Phœnicobius* Mörch.

Shell rather large, varying from depressed-globose or conoidal to elevated and short pupiform ; dextral or sinistral, solid, yellow or brown usually encircled by chestnut bands or lines. *Surface closely malleated or wrinkled all over* ; whorls about 5–5½, the upper ones flattened, the last subglobose or carinated ; peristome expanded or reflexed, its ends not converging, columellar margin dilated over or partly over the rather narrow umbilicus. The columella is rounded. *The nuclear shell is rather large,* (about one-fifth the diameter of the shell), consisting of 2 to 2½ whorls, its junction with the after-growth marked by a (generally) distinct line. The young shells are acutely carinated. Type *cicatricosa* Müll., pl. 19, fig. 8.

Animal having the sole *very indistinctly* tripartite ; *lateral edges of foot with no trace of a foot-margin,* sides of foot granulated in irregular pattern, the tail rather long, rounded above, *with an indistinct slightly impressed longitudinal median line* ; anteriorly there are a few indistinct longitudinal grooves from mantle to head. Mantle-margin with a small triangular right body-lappet, and a longer left one.

Jaw arcuate, strong, typically with numerous strong, separated ribs (pl. 18, fig. 5).

Dentition : *Central and lateral teeth having the mesocones only developed,* the cusps large, cutting-points small (pl. 18, fig. 6). Marginal teeth with a long, oblique, bifid mesocone united at base with the ectocone, which becomes bifid on the outer teeth (pl. 18, fig. 7).

Genitalia : Vestibule short ; penis stout, *continued above in an epiphallus, in which the retractor and then the vas deferens is inserted, and terminating in flagellum* ; penis corrugated within, and having a large papilla at its apex (pl. 18, figs. 2, 4). Vagina stout, bound

to the body-wall by a band of muscles; duct of the spermatheca long (pl. 18, figs. 1 and 3).

Distribution of the typical forms, southern China (provinces Kwang-Tung and Kui-chu) to Burmah and southward.

The most important features of this genus are found in the genital system, which is of the type called by the writer *epiphallophorous*. The penis is continued upward in a flagellum-like extension (epiphallus), in which the vas deferens enters, and which enters the penis itself through a penis-papilla (pl. 18, fig. 2). Thus far, the structure is exactly like *Caracolus* of the West Indies; but *Camœna* differs from *Caracolus* in having the retractor muscle inserted upon the epiphallus instead at the apex of the true penis. The penis-retractor is attached to the floor of the lung-sack. The female system lacks all accessory organs, and the duct of the spermatheca is longer than in *Pleurodonte*. The vagina has strong muscular walls, and is bound to the adjacent right body-wall by a band of muscles (shown in pl. 18, fig. 1); this structure occurs also in the West Indian *Thelidomus* (see p. 96). The teeth are of the *Caracolus* type, being characterized by the total absence of side cusps on centrals and inner laterals. The specimens dissected were received from Dr. v. Möllendorff, without the shell. I take them to be *C. xanthoderma*.

The shell is rather large, capacious, solid, and generally roughly sculptured. The Japanese sinistral helices (*H. quæsita*, etc.) have been associated with *Camœna*, but they belong to a totally different phylum of Helix. The columellar lip is rounded in *Camœna*, not expanded in a flat plate as in *Phania* or *Acavus*.

Perhaps no group of Helices has been less understood by systematists than this. Albers included several very diverse types in his original list of species. Martens restricted the group to large, capacious sinistral helices of true *Camœna* and the very different group *Euhadra*. Pfeiffer united the whole Oriental and Australian series of *Euhadra*, *Camœna* and *Hadra* under the one name *Camœna*. The present writer, in 1890, defined the natural groups of Oriental Helices, and indicated the conchological characters upon which they rest, restricting *Camœna* to forms having a large nuclear shell. This work was criticised by v. Moellendorff (Nachrbl. D. M. G. 1891, p. 195), and several improvements in classification were suggested. These were in large part adopted in a later paper by the writer (Nachrbl. 1892, p. 71).

Subdivisions.

Subgenus CAMÆNA (restricted). Shell capacious, narrowly umbilicated, depressed-globose, often carinated. *Surface malleated or wrinkled. Last whorl not descending in front.* Distribution southern China and Farther India.

Section *Phœnicobius* Mörch. Shell differing from Camæna in the generally more elevated, conoidal or pupiform shape, and in having (typically) four dark spiral bands; the surface varying from smooth to rib-striate, sometimes slightly malleated beneath. Distribution, Philippine Is.

Subgenus PSEUDOBBA v. Moell. Shell rudely sculptured, with wrinkles or furrows oblique to the growth-lines; solid; umbilicus large; peristome thickened, the terminations joined by a cord of callus across the parietal wall. Distribution, Northern Celebes and Sangir Is.

Subgenus CAMÆNELLA Pils. Shell *smoothish*, depressed subglobose, banded and maculated with brown on a white ground; *surface smoothish*; whorls about $5\frac{1}{2}$, the last deflexed in front; embryonal shell less than one-sixth the diameter of the adult. *Columella with an obtuse tooth.* Distribution, Island of Hainan.

Subgenus NEOCEPOLIS Pils. Shell *smoothish*, globose-conical, *with* 6–7 *closely revolving whorls*, the last deflexed in front. Aperture having an internal fold within, marked by a pit outside; *the columellar lip obtusely toothed.* Distribution, Tonquin.

Subgenus CAMÆNA Alb.

The shell is more wrinkled or malleated than in *Phœnicobius*; the last whorl does not descend in front. Of the four principal color bands of this phylum of Helices, band ii (supraperipheral), or band iii (subperipheral) is retained, bands i and iv being absent. Some species show many fine spiral lines of color in addition. The anatomy is described above. The jaw is ribbed. The subgenus is Indo-Chinese in distribution. Many more species will probably be discovered. Type *C. cicatricosa*, pl. 19, fig. 8.

Species.

C. cicatricosa Müll., vi, 198.
senegalensis Fér.
chinensis Voigt.
v. inflata Mlldff., vi, 199.
v. ducalis Anc., vi, 199.

C. longsonensis Morl., viii, 265.
C. jaculata Mab., vi, 120.
C. seraphinica Heude, vi, 199.
C. hahni Mab., vi, 200.
broti d'Ham. & Dautz.
C. subgibbera Mlldff., vi, 200.
C. leonhardti Mlldff., vi, 201.
C. vulpis Gredl., vi, 116.
C. pachychila E. A. Sm., viii, 265.
C. gabriellæ Dautz. & d'Ham., *bathmophora* Mab. [vi, 205.
v. subhainanensis Pils., vi, 205.
C. hainanensis H. Ad., vi, 204.
C. xanthoderma Mlldff., vi, 206.
v. polyzona Mlldff., vi, 207.
C. illustris Pfr., vi, 201.
C. ochthoplax Bens., vi, 202.
C. saturnia Gld., vi, 203.

Section PHŒNICOBIUS Mörch, 1852.

Phœnicobius MORCH, Cat. Yoldi, p. 32, type *H. arata*.—MLLDFF. Nachrbl. D. M. Ges. 1891, p. 202.—PILSBRY, Man. of Conch. viii, p. 266.

The shell is like *Camœna* in the large embryonal portion, consisting of about 2½ whorls. It differs from *Camœna* in being generally more elevated, sometimes pupiform; and most species have all of the four bands (i subsutural, ii supraperipheral, iii subperipheral and iv umbilical) developed. Type *C. arata* Sowb., pl. 19, fig. 13; (See also pl. 19, fig. 12, *C. monochroa*).

The anatomy is unknown. The species are said to inhabit the Philippine islands Tablas, Mindoro, Luban, Busuanga and Palawan; but the localities of some of the pupiform species are not certain. This group has generally been considered a section of Cochlostyla. Dr. v. Möllendorff first pointed out the true affinities of the forms.

Species.

C. arata Sowb., viii, 267.
v. lutea Pils., viii, 267.
C. brachyodon Sowb., viii, 267.
v. naujanica Hid., viii, 268.
C. adusta Sowb., viii, 268.
C. oblonga Sowb., viii, 269.
lubanicus Pfr.
C. oomorpha Sowb., viii, 269.
C. bintuanensis Hid., vi, 237.
C. campanula Pfr., vi, 236.
C. anacardium Dohrn, vi, 238.
C. ceres Pfr., vi, 239.
C. trailli Pfr., vi, 207.
C. monochroa Sowb., vi, 208.
palawanica Pfr.
sauliæ Pfr.
lagunæ Hid.
doriæ Dohrn.
C. palumba Souv., vi, 209.
C. egregia Dh., vi, 210.
C. avus Pfr., vi, 210.

Subgenus PSEUDOBBA Möllendorff, 1891.

Pseudobba v. MOELL., Nachrbl. D. M. Ges. 1891, p. 202, type *H. mamilla*.—*Obba* (typical part) MARTENS, not Gray.

The shell in this group is heavy, solid, rudely sculptured, with a rather large umbilicus. The subgenus is evidently more nearly allied to Phœnicobius than to the continental Camænas. Type *C. mamilla*, pl. 19, fig. 9.

The living animal, as figured by Quoy and Gaimard (Voy. de l'Astrol. pl. 7), agrees with that of *Camæna* in external features.

Jaw of *C. quoyi* horse-shoe shaped, the ends attenuated; cutting edge with a distinct median projection (pl. 15, fig. 11). Viewed in profile, the anterior surface is concave (pl. 15, fig. 12). The color is dark chestnut. Anterior surface smooth; showing by transmitted light fine wavy lines parallel with the margins. (*Schako*, from a half-grown specimen; Mal. Bl. xx, p. 169).

Central and lateral teeth with the mesocones only developed, as in *Camæna*. Marginal teeth with a large, oblique, bifid mesocone and an ectocone; also closely resembling the teeth of *Camæna* (pl. 15, fig. 13, central, lateral and marginal teeth, and fig. 14 a lateral of *C. quoyi*, seen in profile).

The species of this subgenus inhabit northern Celebes and the Sangir Is. It is a satellite group of the Philippine Island Camænas, which has spread southward like a few Obbas and Cochlostylas. The dentition is the same as in *Camæna*, but the jaw (*of an immature specimen* of *quoyi*) lacks ribs; so it seems that in this genus, as in the West Indian *Caracolus*, the presence or absence of ribs is not a generic character. From Quoy's remark that the jaw of *mamilla* is not different from that of French Helices, we presume that it is ribbed in that species.

Species.

C. mamilla Fér., vi, 212.
C. quoyi Desh., vi, 213.
undulata Q. & G., not Fér.
C. linnæana Pfr., vi, 214.
C. tirmaniana Anc., viii, 269.

Subgenus CAMÆNELLA Pilsbry, 1893.

Camœnella PILS., Proc. Acad. Nat. Sci. Phila. 1892, p. 398, type *Helix platyodon* Pfr. (Feb. 14, 1893).

Shell depressed, subglobose, solid, imperforate, banded and maculated, with about 5½ whorls, the last descending in front. Surface

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minutely granular. Peristome well reflexed, the baso-columellar margin toothed. Embryonal shell smooth, two-whorled, between one-sixth and one-seventh the diameter of the adult, its junction with the after growth indicated by a widening of the whorl. Type *C. platyodon* Pfr., pl. 19, fig. 10.

Animal resembling Camæna. Sole *very indistinctly* tripartite, the edges of foot lacking all appearance of a foot-margin; sides irregularly granulated; tail rounded above, *with a median, impressed longitudinal line,* which does not extend quite to the tail.

Jaw strong, dark orange colored, having eight strong ribs (pl. 39, fig. 3).

Central and lateral teeth of the radula (pl. 39, fig. 1) having a single large cusp, which extends about to the posterior edge of the basal plate. Marginal teeth (pl. 39, fig. 2) becoming quadri-cuspid, by the splitting of both mesocone and ectocone.

Genital system (pl. 39, fig. 4) having a very short vestibule. There is no dart-sack or other accessory gland upon the female side; spermatheca duct very long, without diverticulum. Penis stout, exhibiting, when cut open (fig. 5), a very large penis-papilla; from the apex of the penis arises the slenderer epiphallus, which receives the penis retractor at the middle, the vas deferens at the fourth of its length; beyond the insertion of the vas deferens it is continued in a short flagellum.

In anatomy, *Camœnella platyodon* resembles *Camœna* in all respects save that the penis-papilla is larger (a trifling difference) and the cusps of the marginal teeth are much shorter. The shell has a smaller nucleus than in *Camœna*—more as in *Obba*, but not so indistinctly defined; and the maculated white and brown coloration and deflexed last whorl are also as in *Obba*. It differs from *Obba* in lacking an appendix on the penis, and in the ribbed jaw.

C. platyodon Pfr., vi, 239. Island of Hainan.
tournoueri Crosse.

Subgenus Neocepolis Pilsbry, 1891.

Neocepolis Pils., Man. of Conch. vi, p. 235, type *H. merarcha.*

Shell globose, solid, narrowly umbilicated, with elevated spire and *narrow, slowly widening whorls, the last deflexed in front.* Aperture truncate-rounded, *the entire lip reflexed,* its ends joined by a callus. *Columella dilated, thickened and obtusely toothed within.* Typically

having *a strong fold within the outer lip, marked outside by a deep pit*, as in *Cepolis*. Type *C. merarcha*, pl. 39, figs. 9, 10.

Anatomy unknown. The two species are from Tonquin. The relations of the group are problematical, but judging from shell characters, it belongs near either *Obba* or *Camænella*.

C. merarcha Mab., vi, 235. C. morleti Dautz. & d'Ham., vi, 240.
mercatorina Mab., vi, 121.

Genus OBBA Beck, 1837.

Obba Beck, Index Moll. p. 30 (proposed for *H. planulata, papilla, mamilla*).—Gray, P. Z. S. 1847, p. 172 (*H. planulata* selected as the type).—See also Pilsbry, Manual of Conch. vi, p. 211, and viii, p. 270.—*Gallina* Hartm., Erd u. Süsswasser Gast. Schweiz, 1840, p. 197 (*H. rota* Sowb.).—*Philina* (in part) Albers, Die Hel. 1850, p. 119 (preoc.).—*Pusiodon* Swains., in part.—*Obbina* Semper, Reisen im Archip. Phil., Landmoll., ii, p. 123 (type *H. planulata*), 1873.

Shell varying from trochoidal to depressed lens-shaped; carinated, at least in the young; umbilicated; *the surface striated or wrinkled in the direction of growth-lines.* Nucleus composed of about two polished whorls, not distinctly marked off from the after-growth. *Last whorl very deeply deflexed in front, aperture subhorizontal; ends of the expanded peristome approaching, and connected by a cord or raised callus;* basal lip reflexed and often bearing a tooth. Whitish, buff or light brown, banded or speckled with brown. Type *O. planulata*, pl. 19, figs. 14, 15, 16. (See also pl. 19, fig. 17, *O. basidentata*).

Animal having a very broad flat foot, the tail short and quite flat, sole undivided; tentacles short (pl. 39, fig. 7, *O. planulata*).

Jaw smooth, without median projection, or with it small and blunt. Dentition: Central and inner lateral teeth having wide mesocones, no side cusps. Marginals developing a bifid mesocone and an ectocone, the outer marginals having both mesocone and ectocone split showing four short cusps, as in *Camænella platyodon.* (Pl. 39, fig 8, central and marginal teeth of *O. planulata;* pl. 39, fig. 6, an inner marginal of *O. basidentata*).

Genitalia lacking accessory appendages on the female side, the duct of the spermatheca short. Penis short, continued in a long epiphallus bearing the retractor muscle, vas deferens and a flagellum. The

cavity of the penis is strongly, irregularly plicate or papillose. It is encircled by a feather-like glandular appendix (pl. 39, fig. 12), the follicles of each side of which unite into two separate ducts sunken into the cavity of the penis (pl. 39, fig. 13, section of the gland). See pl. 39, fig. 11–13, *O. planulata.*

Distribution, Philippine Islands, with a few forms in northern Celebes, Halmaheira, and Ceram.

This group, like *Cochlostyla*, seems to have originated in the Philippine Island area. A few stragglers are found to the southward, as is also the case with *Camœna* and some other typically Philippine groups.

Obba differs from *Camœna* chiefly in the less capacious shell, with subhorizontal aperture and continuous peristome; in the possession of a glandular appendix on the penis, the short spermatheca duct, and the smooth jaw. It differs from *Planispira* in the raised parietal callus and the keel of the shell, which is characteristic of all the species when young, and most of them when adult. The teeth are like those of *Camœnella* and *Planispira*. The anatomy of *O. planulata*, *listeri* and *basidentata* has been examined by Semper (Reisen, Landmoll., ii, p. 120); the jaw of *rota* by Mörch.

In Vol. VI of this work the writer stated that *Helix mamilla* was the type of *Obba*, following v. Martens. But in 1847 Gray selected *H. planulata* for the type. The genus must, therefore, be restricted to species allied to *planulata.*

(*Group of O. planulata.*)

O. papilla Müll., vi, 216.
  v. heroica Pfr., vi, 217.
O. listeri Gray, vi, 218.
  v. costata Semp., vi, 219.
O. gallinula Pfr., vi, 219.
  v. morongensis Mlldff. viii, p. [270.
O. planulata Lam., vi, 220.
  auriculata Swains.
  papilionacea Val.
  collapsus Perry.
  v. sarcochroa Pils., vi, t. 68, f. [85.
O. calcar v. Mart., vi, 221.

(*Group of O. moricandi.*)

O. moricandi Sowb., vi, 222.
O. basidentata Pfr., vi, 223.
O. livesayi Pfr., vi, 223.
O. scrobiculata Pfr., vi, 224.
O. rota Sowb., vi, 225.
O. platyzona Mlldff.

(*Group of O. marginata.*)

O. bigonia Fér., vi, 226.
samarensis Pfr., *olim.*
bizonia H. & A. Ad.
O. marginata Müll., vi, 227.
grayana Pfr.
grayi Hombr. & Jacq.
scabrosa Fér.
v. griseola Mlldff., vi, 228.
v. sororcula v. Mart., vi, 228.
devincta Tap. Can.
O. kobeltiana Pfr., vi, 228.
O. parmula Brod., vi, 229.
discus Dh., vi, 230.
f. obscura Mlldff., vi, 230.
f. elevata Mlldff., vi, 230.
f. trochoidea Mlldff., vi, 230.
O. bustoi Hid., vi, 230.
O. saranganica Hid., vi, 230.
O. kochiana Mlldff., vi, 231.
O. bulacanensis Hid., vi, 226.

(*Group of O. horizontalis.*)

O. horizontalis Pfr., vi, 232.
O. reeveana Pfr., vi, 233.
O. lasallii Eyd., vi, 233.
meretrix Sowb.
O. columbaria Sowb., vi, 234.

Subgenus? OREOBBA Pilsbry, 1894.

Janira ALBERS, Die Heliceen, 1850, p. 124, only species *H. codonodes.* Not *Janira* Leach, 1813 (Crustacea), of Oken, 1815 (acalepha) or of Schumacher, 1817 (*Pecten*).

Shell globose-conoidal, *bullet-shaped*, composed of about 5 whorls which are carinated in immature shells; the embryonal portion not differentiated; last whorl deflexed in front. *Surface shining, microscopically spirally striated.* Aperture truncate-rounded; entire lip well reflexed, at the columella expanded partly over the narrow umbilicus, and armed with a callous tooth on the inner edge. Type *H. codonodes* Pfr., pl. 19, fig. 11.

Animal unknown. *O. codonodes* inhabits the Nicobar Islands. It resembles the Philippine Island group *Phœnicobius* in contour, but not in texture or minute sculpture, nor in the apical whorls. The sculpture is like that of the *Obba horizontalis* group. Of the two species I have seen only *codonodes.* A knowledge of the anatomy is necessary to the exact location of this group in the system. It cannot, in my opinion, be united to *Phœnicobius.*

O. codonodes Pfr., vi, 236.
O. camelus Pfr., vi, 237.

Genus PLANISPIRA Beck, 1837.

=*Planispira*+*Cristigibba*+*Angasella*+*Trachia*+*Eurystoma*.

Planispira Beck, Index Moll., subg. 25, p. 29.—Martens in Albers' Die Heliceen, p. 160, type *H. zonaria* L.—Semper, Reisen, im Arch. Phil., Landmoll., p. 120.—Tapparone-Canefri, Ann. Mus. Civ. Genov. xix, p. 162, 181, 1883.—Pilsbry, Manual, vi, p. 274.—*Pusiodon* (in part) Swains., Malacol., p. 330 (for *H. zonaria* and *auriculata*).—*Philina* (in part) Albers, Die Hel., p. 119.

Shell depressed, generally umbilicated, having four to five rapidly widening whorls, *the first not granulated nor marked by hair points*, the last *deeply deflexed in front*. Aperture very oblique or subhorizontal; outer and upper lips expanded, basal lip reflexed, often toothed. Type *P. zonaria* L., pl. 12, figs. 4, 5, 6.

Animal having the sole undivided (pl. 12, fig. 2, *P. zonaria*).

Genital system lacking all accessory organs on the female side, the large spermatheca situated on a very long duct. Penis thick and long, the retractor muscle apparently inserted at its apex; epiphallus ending in a short flagellum (pl. 12, fig. 1, *P. zonaria*).

Jaw smooth, arcuate (pl. 12, fig. 7 *P. zonaria*.)

Middle tooth and inner laterals with a single obtuse cusp; outer laterals and marginal teeth with the ectodont developed (pl. 12, fig. 3, *P. zonaria*).

Distribution, southern Celebes, Moluccas, New Guinea; aberrant groups extending over the Indo-Malayan and part of the Australian regions.

This genus differs from *Chloritis* in the white or pale colored, banded shell, very oblique aperture, and lack of quincuncial sculpture on the apex, and in the smooth jaw. It differs from *Papuina* in the depressed earlier whorls of the shell and the ribless jaw. It agrees with *Obba* in the jaw, but differs in lacking an appendix upon the penis, and in the typically thinner, smoother shell, depressed at the apex.

The anatomy is imperfectly known from the work of Semper and Tapparone-Canefri. Investigation should be directed to the penis in order to ascertain whether a papilla is present (denied by Semper), the true limits of penis proper and epiphallus, and the point of insertion of the penis retractor. v. Martens describes the jaw of *P. loxotropis* as weakly ribbed. It is probable that the complete absence

of ribs will prove to be a character not without exceptions in this, as in some allied genera.

The genus is divided into four well-defined subgenera:

** Shell white or light colored, generally banded, smooth, the earlier whorls flat or concave.*

Subgenus PLANISPIRA (restricted). Shell with no crest-like ridge behind the lip; aperture decidedly wider than high, the basal lip usually somewhat thickened or toothed. Penis having a flagellum.

Subgenus CRISTIGIBBA Tap.-Can. Shell with a crest or swollen ridge behind the lip; aperture about as high as wide, the basal lip narrow, not thickened or toothed. Penis very short, the retractor and vas deferens inserted at its apex; no flagellum.

** * Shell often roughly sculptured, the earlier whorls not especially depressed.*

Subgenus ANGASELLA A. Ad. Shell depressed, the whorls tubular, costulate or granulated; aperture rounded or angular, the lip well expanded, reflexed below. Australian species.

Subgenus TRACHIA Alb. Shell varying from discoidal to depressed globose, generally banded on an opaque whitish ground. Last whorl deeply deflexed in front. Lip expanded, reflexed below. Anatomy as in *Planispira* except that the jaw is ribbed. Indo-Malayan species.

Subgenus PLANISPIRA Beck.

Anatomy described above.

(*Group of P. zonaria*).

P. zebra Pfr., vi, 275.
guttata LeGuill.
v. embrechtiana Mouss., vi,
P. iaddæ Pils., vi, 276. [275.
P. halmaherica Strub., viii, 284.
P. chariessa Pils., vi, 279.
P. quadrifasciata LeGuill., vi,
v. instricta Mart. [280.
edentata Mart.
P. aurita Mart., vi, 281.
P. biconvexa Mart., vi, 281.
P. scheepmakeri Pfr., vi, 282.
P. zonaria Linn., vi, 277.
f. lineolata Mart.

P. zonaria Linn.
f. fulminata Mart.
f. obliquata Mart.
f. maculosa Mart.
f. coluber Beck.
lunulata Mart.
v. fasciata Mart.
f. collis Mouss.
f. nitidiuscula Bttg., viii, 284.
v. fasciolata Less.
v. martini Schepm. Leyd. Mus. [xv.

(*Group of P. endoptycha*).

P. endoptycha Mart., vi, 282.
? compta H. Ad.
P. porcellana Grat., vi, 283.

(*Group of P. zonalis*).

P. zonalis Fér., vi, 284.
leucostoma A. & R.
P. atrofusca Pfr., vi, 285.
P. latizona Pfr., vi, 285.
P. atacta Pfr., vi, 287.
P. loxotropis Pfr., vi, 285.
f. bernsteinii Mart.
f. laticlavia Mart.
f. angusticlavia Mart.
f. pluricincta Mart.
v. lorquini Pfr., vi, 286.

(*Group of P. kurri*).

P. kurri Pfr., vi, 287.
P. tietzeana Rolle, Nachrbl. '93, [p. 33.
P. surrecta Bttg.
P. flavidula Mart., vi, 288.
flaveola Mts. not Kryn.

(*Group of P. exceptiuncula*).

P. exceptiuncula Fér., vi, 289.
f. phryne Pfr.
f. aspasia H. Ad.
P. thetis Pfr., vi, 290.
(see Nachrbl. 1892, p. 43).

Subgenus CRISTIGIBBA Tapparone-Canefri.

Cristigibba T.-C., Ann. Mus. Civ. Genov. xix, 1883, p. 161.

With the general appearance of *Planispira*, these shells differ in having a crest or swollen ridge behind the lip, or a strong swelling on the base immediately behind the constriction preceding the lip. The spire is flat, a little concave in the middle. Type *P. corniculum*. (See pl. 12, fig. 13–15, *C. macgregori* Hedley.).

The group is characteristic of New Guinea, but a few species range as far north as Ceram, Batjan, and even Borneo and Sumatra.

Jaw arcuate, smooth (pl. 12, fig. 9, *C. dominula*). In *C. macgregori* the lower margin shows traces of denticulation, and the median portion is transversely wrinkled (pl. 12, fig. 11).

Central and inner lateral teeth with a single cusp, shorter than the basal-plates. Marginals having a long, oblique, bifid mesocone and a small ectocone.

Genital system like that of *Planispira* on the female side. Penis *extremely short*, stout, *the retractor and vas deferens inserted at its apex* (pl. 12, fig. 8, *P. plagiochila*; pl. 12, fig. 12, *P. dominula*).

In this group the epiphallus and flagellum have evidently been lost by degeneration. The anatomy of several species is known through the researches of Tapparone-Canefri and Charles Hedley.

The following list of species will probably suffer considerable reduction when sufficient material for comparative study is brought together.

(*Group of P. corniculum*).

P. corniculum H. & J., vi, 291.
? kiesneri LeGuill.
P. purpurostoma LeGuill., vi, [177.
P. deaniana Ford, vi, 292.
P. dominula Tap.-Can., vi, 293.
P. macgregori Hedl., viii, 285.

(*Group of P. tortilabia*).

P. tortilabia Less., vi, 294.
torticollis (LeGuill.), T.-C.
gibbosula H. & J.
P. plagiocheila T.-C., vi, 295.
P. rhodomphala T.-C., vi, 297.
P. semirasa Mouss., vi, 295.
moluccensis Pfr.
P. leptocheila T.-C., vi, 296.

(*Group of P. margaritis*).

P. margaritis Pfr., vi, 297.
v. zonulella Mouss.
P. mersispira Mart., vi, 298.
P. expansa Pfr., vi, 298.
anozona Mart.
P. quadrivolvis Mart., vi, 299.

Subgenus ANGASELLA A. Ad.

Angasella A. AD., P. Z. S. 1863, p. 521, only species, *cyrtopleura*. *Pleuroxia* ANCEY, Conchologists' Exchange, ii, p. 38 (Sept., 1887), same type. Not *Angasiella* Crosse, 1864 (Nudibranchiata).

Shell depressed, umbilicated, plicate-striate; whorls 4 to 5, the last wide, deflexed in front. Aperture oblique, oval-truncate, the

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peristome expanded, reflexed below, not toothed, margins approaching and joined by a parietal callus. Type *P. cyrtopleura*, pl. 19, figs. 20, 21, 22.

Distribution, South Australia. Anatomy unknown.

This group contains snails allied to the *P. tuckeri* group of the islands off the north coast of Australia, but modified by the conditions of life in an arid region. Still it is doubtful whether the separation of the two groups serves any useful purpose.

Species.

P. cyrtopleura Pfr., iv, 65.
P. phillipsiana Ang., iv, 66.
P. eyrei Ad. & Ang., iv, 66.
P. subsecta Tate, iv, 66.

Section *Trachiopsis* Pilsbry.

Trachiopsis PILS., Manual of Conch. viii, p. 284.

Shell small, depressed, umbilicated, the whorls rather cylindrical, covered with a brown cuticle, the last deflexed in front and more or less constricted behind the lip. Aperture round or angular, oblique, the lip thin, well expanded or reflexed, sometimes toothed. Type *P. tuckeri* Pfr., pl. 19, fig. 18, 19.

Anatomy unknown. These small Planispira-like shells have hitherto been classed in *Trachia*, an Indian group. They inhabit the northern coast of Australia and adjacent islands. It is doubtful whether this group should be separated from *Angasella*. It differs mainly in the lighter, thinner texture of the shell, and the tendency to form a tooth upon the basal lip.

P. tuckeri Pfr. iv, 65.
strangulata H. & J.
P. cyclostomata LeGuill., iv, 65.
P. dentoni Ford, viii, 285.
P. dryanderensis Cox, P. Z. S., [1872, p. 19.
P. delessertiana LeGuill., iv, 66.
taranaki Gray.
torresiana H. & J.
P. endeavorensis Braz., P. Z. S. [1871, 640.
P. baudinensis Smith, viii, 286.
P. collingii Smith, viii, 287.

Subgenus TRACHIA Albers, 1860.

Trachia ALB., Die Hel., edit. 2, p. 160.—STOLICZKA, Journ. Asiat. Soc. Beng. xl, (2), p. 223 (anatomy).—*Eurystoma* ALB., Die Hel. 1850, p. 126; edit. 2, 1860, p. 129, type *H. vittata*.—*Cf.* SEMPER,

Reisen im Archip. Phil., Landmoll., p. 163, anatomy of *H. vittata*.—Not *Eurystoma* Raf. 1818, nor *Eurystomus* Vieill., 1816.—*Philidora* de Morgan, Bull. Soc. Zool. France, 1885, p. 384 (proposed for *P. wrayi* and *hardouini*).

Shell varying from discoidal to depressed-globose, umbilicate, the surface rather roughly sculptured, hairy when young, microscopically granulated, sometimes ribbed when adult; the apex typically showing no distinct sculpture. *Last whorl strongly deflexed in front.* Aperture very oblique, small, the lip well expanded, reflexed below, *the terminations approaching* and sometimes connected by a raised callus. Type *P. asperella*, pl. 19, fig. 25. (See also pl. 19, fig. 24, *P. vittata*; and pl. 19, fig. 23, *P. vittata var. spinolæ*).

Animal (of *P. delibrata*) having the left body-lappet of the mantle represented by a simple thickening; right lappet reaching anteriorly over the back and rapidly becoming narrower below. In *P. vittata* the sole is indistinctly tripartite.

Jaw arcuate, the entire anterior surface ribbed, the seven median ribs stronger (pl. 32, fig. 44, *P. delibrata*. Pl. 34, fig, 5, *P. trochalia*). In *P. vittata* there are five very high ribs, strongly denticulating the margin.

Radula (of *P. delibrata*) very long, with 124 transverse rows of 22 (to 18) 20.1.20.18 (to 22) teeth. Central and inner lateral teeth with a large mesocone and obsolete side cutting-points; outer laterals and marginal teeth with the ectocone developed. In *P. vittata* the formula is about the same; central and inner 14 laterals unicuspid; outer laterals with an ectocone. At the 25th tooth the mesocone becomes bifid, and outwardly the bifid mesocone becomes shorter, the outermost marginals having three subequal cusps. See also pl. 34, fig 4, *P. asperella*, and pl. 34, fig. 6, *P. trochalia*.

Genitalia having the female side free from all accessory organs, the duct of the spermatheca very long. Penis terminating in an epiphallus near the root of which the retractor is inserted; epiphallus long, terminating in a short flagellum and the vas deferens (pl. 32, fig. 45 *P. delibrata*). The genitalia of *P. vittata* are similar; penis with a spirally coiled flagellum. In *P. penangensis* (pl. 42, fig. 6) the penis bears an epiphallus ending in a short flagellum, and has an accessory sack, perhaps an "appendix."

Distribution, India, Burmah, Ceylon, Mergui Archipelago and Sumatra.

These shells are characterized by the deeply descending whorl at the aperture, and the strongly converging ends of the lip. The anatomy is in essential agreement with either *Chloritis* or *Planispira*, although the strong ribbing of the jaw is most like the former group. On the other hand, the general form of the shell, the deep descent of the last whorl to the very oblique aperture, and the system of coloring, agree more nearly with *Planispira*. The sculpture of the shell varies considerably in the different species. The more typical, such as *fallaciosa, nilagirica, proxima,* as well as *vittata* exhibit an apparently smooth apex; but *propinqua, tanqueryi* and a few others, show an excessively fine quincuncial puncticulation of the apical whorls, such as occurs in *Chloritis*, in combination with the characteristic shell contour of *Trachia*. Until we know by the examination of numerous species, how and to what extent the characters of jaw and genitalia are correllated with the above-mentioned shell structures, no consistent zoologist will be justified in drawing rigid lines of demarcation between the *Chloritis* and *Planspiras* of southeastern Asia. It is better to frankly recognize the fact that in this area the two groups are represented by some forms which, so far as shell characters show, are undifferentiated or separated by feeble characters only.

(*Group of P. fallaciosa*).

P. albicostis Pfr., iv, 65.
P. asperella Pfr., iv, 62.
granifera Bens.
P. atkinsoni Theob., iv, 56
P. contracta Hutt., iv, 65.
P. delibrata Bens., iv, 64.
procumbens Gld.
v. fasciata G.-A., iv, 64.
v. khasiensis Nev., iv, 64.
P. fallaciosa Fér., iv, 64.
P. footei Stol., iv, 64.
P. helferi Bens., iv, 63.
P. nilagirica Pfr., iv, 65.
P. penangensis Stol., iv, 63.
P. proxima Fér., iv, 63.
P. ruginosa Fér., iv, 63.
v. crassicostata Bens., iv, 64.
P. sordida Pfr., iv, 65.
P. vittata Müll., iv, 120.
zonula Wood.
v. spinolæ Villa, iv, 120.

(*Group of P. gabata*).

P. trochalia Bens., vii, 88.
bigsbyi Tryon.
P. gabata Gld., iv, 57.
v. merguiensis Phil.
P. pilisparsa Mart., viii, 192.
P. smithii Bock, iv, 57.
P. wrayi Morg., vii, 86.
P. hardouini Morg., vii, 86.

Genus CHLORITIS Beck, 1837.

Chloritis Beck, Index Moll. subg. 24, p. 29.—Gray, P. Z. S. 1847, p. 172, type *H. ungulina*.—v. Mart., in Alb., Die Hel. 1860, p. 161, type *H. ungulina* L.—*Erigone* Alb., Die Hel. 1850, p. 92 (for *discordialis* Fér.).—*Semicornu* "Klein," H. & A. Adams, Gen. Rec. Moll. ii, p. 202, 1855.—*Cf.* Pilsbry, Man. of Conch. vi, p. 242; viii, p. 270; and v. Moellendorff, P. Z. S. 1891, p. 335, 336.+*Sulcobasis* Tap.-Can., *Austrochloritis* Pils., *Trichochloritis* Pils. and *Plecteulota* Mlldff.

Shell varying from *discoidal and biconcave* to depressed subglobose with convex spire; the apical whorl flattened or sunken, and showing under a lens *regularly arranged granules or hair-points*, which often persist over the whole shell. Aperture lunate, the lip reflexed. Type *C. ungulina* L., pl. 29, figs. 1, 2, 3.

Animal (of *C. porteri*) with undivided sole, the edges of the foot lacking a foot border; sides irregularly granulated; tail rounded, *above with an impressed longitudinal median line*; back from mantle to head having a few longitudinal grooves. Mantle edge bearing a small right body-lappet.

Jaw strong and ribbed.

Radula having the middle cusp only developed on central and inner lateral teeth, the cutting points about as long as the basal plates; side cusps completely absent, but represented by small cutting points. Lateral teeth with a long, oblique, bifid mesocone and a small ectocone.

Genital system characterized by the lack of dart sack or other accessory organs on the female side, the spermatheca duct rather long and closely bound to the uterus. Penis without appendix, its cavity containing at the apex an imperforate fleshy papilla (pl. 28, fig. 2), situated beside the opening of the epiphallus; epiphallus (pl. 28, figs. 1, 2, *C. porteri*) long, the penis retractor inserted upon it; terminating in a flagellum and vas deferens.

Distribution, Northern Australia and Solomon Is., north to southern China. No fossil forms are known. All of the species live upon the ground, as far as known.

The genus *Chloritis* was originally proposed for flat, biconcave Helices; but modern systematists have widened the group to contain allied forms having the spire convex. Early in 1891 the writer discussed the group, fixing upon the previously unnoticed character of *a quincuncially granulated apex* as the true generic

criterion, and considerably widening the limits of the genus. At about the same time Dr. v. Möllendorff redefined *Chloritis*, and concluded that the sculpture of "impressed points placed in quite regular quincunx," and the presence of a "keel or angle round the umbilicus" were diagnostic generic characters. In this connection it should be noticed that the hairs or hair-points are totally lacking upon the outer whorls of many undoubted *Chloritis*, and that the umbilical angle completely fails in *C. circumdata, maforensis, percussa*, etc. It therefore appears that the most we can say of the sculpture is: *apical whorls and usually the whole shell sculptured with hair-points arranged in quincunx.* It is probable that when hairs or hair-points are present on the last whorl, they are *always* disposed in regular oblique sweeps or quincunx, but this cannot be said to be demonstrated. Some species show a granulation between the hair points. The European Oligocene and Miocene species which have been referred to *Chloritis*—such as *H. lepidotricha* A. Br., have no relationship to the Oriental *Chloritis*; the *H. lepidotricha* is a *Campylæa.* In this connection it must be emphatically stated that while the character of surface-sculpture discussed above distinguishes *Chloritis* from other groups inhabiting the same quarter of the globe, it is not in itself a feature of much importance, nor in itself diagnostic of this genus alone. In Europe the hairy forms of the *Campylæa planospira* group (as well as some other Campylæas, such as *setosa* Ziegl.) *show absolutely the same surface sculpture*, from the apex out. On the other hand, the Australian group *Hadra* is extremely close to *Chloritis* in anatomy, but lacks the quincuncial sculpture. We may, therefore, regard the quincuncially arranged hairs as a secondary character, which has arisen independently in several widely different groups of Helices. The function of the hairs is evidently to gather dirt, thus disguising the snail from its bird enemies.

Chloritis has the essential internal organization of *Camœna, Camœnella*, etc. It differs from these groups and from *Obba*, mainly in the non-differentiation of the embryonal whorls, and the smaller size of the shell at the time its independent life begins. The species referred by Semper to *Chloritis* belong to an entirely different group. His anatomical characterization of the genus therefore falls.

Chloritis may be divided into several sectional groups—*Chloritis, Sulcobasis, Austrochloritis, Trichochloritis*—probably natural, but

blending at their confines into one another. The typical forms of the first two represent the more divergent and presumably modern lines of differentiation.

Section *Chloritis* (restricted).

Shell with the spire sunken, flat or somewhat convex with flat earlier whorls. Type *C. ungulina*, pl. 29, figs. 1, 2, 3.

But two species of the typical group of Chloritis have been investigated anatomically, *C. dinodeomorpha* Tap.-Can., Ann. Mus. Civ. Genov. xix, 1883, p. 168, and *C. leei* Cox, Hedley, Proc. Linn. Soc. N. S. W. (2), vi, p. 687. They agree essentially with *Austrochloritis*, q. v.

Jaw arcuate, having about 8 strong ribs separated by narrow intervals (pl. 32, fig. 43, *C. leei*). Central and inner lateral teeth unicuspid; marginal teeth having a long bifid mesocone and an ectocone. Genitalia lacking appendages on the female side, the duct of the spermatheca long. Penis long, the retractor apparently inserted at its apex; epiphallus very long, dilated where it receives the vas deferens, and ending in a flagellum (pl. 28, fig. 10, *C. dinodeomorpha*, after Tap.-Can.; pl. 32, fig. 42, *C. leei*, after Hedley).

Distribution, New Guinea and Moluccas (typical forms); Solomons, New Ireland, Louisiades and Celebes (divergent forms).

(*Group of ungulina.*)

C. ungulina Linn., vi, 243.
v. minor Fér.
C. unguiculina v. Mart., vi, 244.
C. biomphala Pfr., vi, 244.
C. martensi Pfr., vi, 244.
C. cheratomorpha Tap.-Can., vi, 245.

(*Group of circumdata.*)

C. circumdata Fér., vi, 246.
molliseta Pfr., vi, 246.
C. lansbergiana Dohrn, vi, 247.
C. maforensis Tap.-Can., vi, 247.
v. micromphalus Pils., vi, 247.

(*Group of unguicula.*)

C. unguiculastra v. Mart., vi, 248.
v. buruensis Mart.
v. amboinensis Mart.
v. pilosa Mart.
C. flexuosa Pfr., vi, 249.
C. ceramensis Pfr., vi, 249.
C. unguicula Fer., vi, 249.
yoldii Mörch.
C. gruneri Pfr., vi, 250.
C. exacta Pfr., vi, 250.

(*Group of eustoma.*)

C. erinacea Pfr., vi, 251.
C. leei Cox, vi, 251.
v. sudestensis Hedley.
C. subcorpulenta Sm., vi, 251.
C. discordialis Fér., vi, 252.
C. eustoma Pfr., vi, 252.
C. dentrecasteauxi Sm., vi, 253.
C. ursina Pfr., vi, 253.
C. dinodeomorpha Tap.-Can., vi, [254.
C. delphax Dohrn, viii, 271.
C. silenus Angas, vi, 254.
C. gaimardi Dh., vi, 255.
adustus Hinds.
C. mendanæ Cox, vi, 255.

(*Group of tuba—Celebes species.*)

C. bulbulus Mouss., vi, 258.
bulbus Mouss.
C. tuba Alb., vi, 258.
C. zodiacus Fér., vi, 259.

Section *Sulcobasis* Tap.-Can.

Sulcobasis T.-C., Annali del Museo Civico di Storia Naturale di Genova, xix, 1883, p. 161.

Shell *large*, *solid*, globose-depressed or depressed; spire convex, *the inner whorls* (and apex when not worn) *showing minute hair-scars arranged in oblique series; body-whorl more or less distinctly spirally sulcate beneath.* Lip well reflexed. Type *C. sulcosa* Pfr., pl. 29, figs. 9, 10.

Distribution, Aru Is., New Guinea, New Ireland, Solomon Is.

Anatomy unknown. Tapparone-Canefri has given a crude figure of the central and inner lateral teeth of *C. beatricis*, showing them them to lack side cusps, as usual in the genus. Doubts have been expressed as to the relationship of this group of large solid Helices to *Chloritis* (Jahrb. D. M. G. 1892, p. 94); but those who see the shells themselves, will agree with Tapparone-Canefri that the group is simply a section of *Chloritis*.

(*Typical group*).

C. sulcosa Pfr., vi, 260.
C. rubra Alb., vi, 260.
C. concisa Fér., vi, 262.
C. beatricis Tap.-Can., vi, 260.
C. rohdei Dohrn, viii, 273.
C. lepidophora Dohrn. viii, 273.
C. rehsei v. Mart., vi, 261.
gerrardi Sm.
genardi Braz.
v. obtecta Reinh., vi, 262.

(*Aberrant group*).

C. bougainvillei Pfr., vi, 128.
angasiana Newc.
C. majuscula Pfr., vi, 255.
C. isis Pfr., vi, 256.
C. quercina Pfr., vi, 257.
v. hombroni Pfr., vi, 258.
janellii Hombr. & Jacq.

Section *Austrochloritis* Pilsbry.

Austrochloritis Pils., Man. of Conch. vi, p. 262.—? *Plecteulota* v. Moell., Jahrb. D. M. Ges. 1892, p, 92, type *Eulota goniostoma* Mlldff.

Shell rather small, depressed, but with convex spire and obtuse apex, umbilicated, unicolored; surface hairy or *marked with regular series of hair-scars to the apex.* Aperture round-lunar, the lip expanded, thin, ends of peristome converging; sutures well-impressed. Type *C. porteri* Cox, pl. 29, figs. 4, 5.

Animal (see under *Chloritis*).

Jaw arcuate, with numerous ribs (pl. 28, fig. 3, *C. porteri*).

Dentition: Central and inner lateral teeth with the mesocones only developed, slight lateral cutting-points upon it representing the absent ectocones. Marginals having a long, oblique mesocone and a small ectocone (pl. 28, fig. 4, *C. porteri*).

Genitalia (of *C. porteri*) lacking all accessory appendages on the female side; spermatheca lying beside the albumen gland, its duct therefore very long, bound closely to the oviduct thoroughout its length. Penis club shaped, the walls of its cavity corrugated, with a large, fleshy papilla at the apex, beside the opening of the epiphallus (pl. 28, fig. 2). Epiphallus long, the retractor inserted at its middle; ending in a rather long flagellum. Penis retractor attached to the floor of the lung cavity; right eye-peduncle retractor passing between primary branches of genitalia (pl. 28, fig. 1 *C. porteri* Cox. Fig. 2 penis of same opened, epiphallus and flagellum).

Distribution, Queensland, New Guinea and adjacent islands.

The anatomy of *P. porteri* has been investigated by Hedley (Proc. Roy. Soc. Queensl. vi, pl. 15) and by myself (see above). The jaw and teeth of *C. chloritoides* have been figured by Hedley (Proc. Linn. Soc. N. S. W. (2), vi, pl. 39, 40). The anatomy of *C. argillacea* has been described and figured by Wiegmann, in Webers' Zool

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Ergebnisse einer Reise in Niederländisch Ost- Indien, III, p. 171. Part of his figures are reproduced on pl. 28, figs. 5–9. The epiphallus bears a short accessory organ (shown below the penis retractor in fig. 8, above it in fig. 9) of unknown homology and function. Otherwise the jaw, teeth and genitalia agree with *C. porteri*.

The section *Plecteulota* of v. Möllendorff, considered by him to be a subordinate group of *Eulota*, probably belongs here. Its type *Plecteulota goniostoma* Mlldff. is shown in pl. 29, figs. 6, 7.

Small, thin-shelled forms, having much the aspect of *Eulotella*, from which they differ in the sculptured apex and the lack of dart-sack and the associated mucus gland or glands. It is in actual practice, however, extremely difficult to tell what shells to refer to *Eulotella*, what to *Chloritis;* and the most experienced conchologists differ in their treatment of the forms. Most of the shells now included in *Austrochloritis* were placed by Pfeiffer in *Dorcasia* and *Camœna;* and v. Möllendorff has expressed the opinion that part of them are to be referred to *Eulota* (*plus* Plecteulota, Eulotella, etc.). In regard to these conflicting opinions, the writer has only this to say: the groups *Eulota* and *Austrochloritis*, notwithstanding their superficial similarity, belong to widely different branches of the Helix stock. Controversy respecting the generic position of certain species known by the shells alone is idle; for the anatomy only can give a true answer to our questioning.

(*Australian species*).

C. spinei Cox, vi, 263.
hystrix Cox, preoc.
C. porteri Cox, vi, 263.
C. mansueta Cox, vi, 264.
C. blackalli Braz., vi, 264.
C. buxtoni Braz., vi, 265.
C. brevipila Pfr., vi, 265.
C. aridorum Cox, vi, 266.
C. pseudoprunum Pils., viii, 271.
prunum auct. not Fér.
C. coxeni Cox, viii, 272.
C. bennetti Braz., vi, 135.
C. blackmani Cox, vi, 137.
C. coxenæ Braz., vi, 138.
C. mucida Pfr., vi, 148.

(*Species of New Guinea, etc.*).

C. occulta Pfr., vi, 266.
C. chloritoides Pils., vi, 267.
C. rhodochila Mlldff., viii, 273.
C. micholitzi Mlldff., viii, 272.
C. goniostoma Mlldff., viii, 221.
C. telitecta Mlldff., viii, 222.
C. tenuitesta Mlldff., viii, 273.
C. argillacea Fér., iii, 210.
cyclostomopsis Lea.
C. mendax Martens, iii, 212.

Section *Trichochloritis* Pilsbry.

Trichochloritis Pils., Manual of Conch., vi, p. 267.

Shell depressed, rather thin, the spire low-convex or flat, the base generally obtusely angled around the umbilicus. Epidermis not deciduous; apex and the whole shell hirsute or marked by hair-scars arranged in regular lines; lip thin, expanded or narrowly reflexed. Type *C. breviseta* Pfr.

Anatomy unknown. Distribution, Southern China to Borneo.

As I have written in this work (vi, p. 242) and von Möllendorff has emphasized (Nachr., 1892, p. 94), the sections of *Chloritis* stand "auf etwas schwachen Füssen." In other words, the series seems to intergrade by rather easy stages throughout, not even excepting *Sulcobasis*. Disclaiming any desire to supply crutches to a section which cannot stand upon its own merits, I still retain the name *Trichochloritis* for the group of small, thin species having the same distribution as *Camœna*, believing it a convenient division. When enough species are known anatomically to show the true classification of *Chloritis* and the line dividing that genus from *Trachia* and *Eulotella*, I shall be among the first to discard the present arbitrary system.

The genital system of *C. crassula* has been figured by Wiegmann (Zool. Ergebnisse einer Reise in Niederländisch Ost-Indien. iii, pl. 13, f. 10). It resembles that of *C. portei* except that the enlargement at the apex of the penis is long and curved—so long that Wiegmann calls it a penis gland, although in my opinion, it is not glandular, but simply a pouch-like enlargement of the penis for the accomodation of a large imperforate papilla.

The epiphallus bears the retractor, and is continued beyond the insertion of the vas deferens in a short flagellum. The duct of the spermatheca is much and abruptly swollen at the base and this swelling is doubtfully interpreted as a dart-sack and mucus gland by Wiegmann, who did not open it, however. If his view is correct, the species must be an *Eulotella;* but I prefer to consider the structure as a mere muscular enlargement of the spermatheca duct, probably with plicate internal walls, such as is often found in the Helices. The union of dart-sack with spermatheca duct would be an extremely unusual character, if confirmed.

(*Continental species*).

C. hungerfordiana Nev., iii, 182.
C. miara Mab., vi, 270.
C. herziana Mlldff., vi, 271.
C. rhinocerotica Hde., vi, 271.
C. franciscanorum Gred., viii, [217.
C. seriatiseta Roch., vi, 268.
C. malayana Mlldff., viii, 274.
C. percussa Hde., vi, 111.
C. breviseta Pfr., vi, 268.
C. tenella Pfr., vi, 269.
C. submissa Desh., iii, 182.
C. deliciosa Pfr., vi, 113.
C. remoratrix Morl., viii, 274.
C. lemeslei Morl.
C. balansai Morl., viii, 218.
C. quinaria Pfr., vi, 269.
guinaria Pfr.
C. shanica Bedd., viii, 275.
C. colletti Bedd., viii, 274.
C. bifoveata Bens., vi, 245.
C. nautiloides Val., iii, 212.
C. samuiana Mlldff.
C. tanqueryi C. & F., iv, 64.
C. condoriana C. & F., vi, 269.
C. norodomiana Morl., vi, 270.
C. fouresi Morl., J. de C., 1889, [176.
C. propinqua Pfr., iv, 63.

(*Species of Borneo, Java, etc.*).

C. crassula Phil., viii, 271.
storiana Mouss.
C. cryptopila Marts., iii, 211.
v. helicinoides Mouss., iii, 211.
C. everetti H. Ad., iii, 211.
C. hemiopta Bens., vi, 238.
C. meander G.–A., viii, 275.
C. plena G.–A., viii, 276.
C. sibutuensis Sm., Ann. Mag., [1894, p. 53.
C. tomentosa Pfr., iii, 212.

(*Philippine Island species*).

C. brevidens Pfr., vi, 272.
C. leytensis Mlldff., Nachr. '90, [203.
C. malbatensis Hid.
C. quieta Rve., vi, 271.
C. inquieta Dohrn, viii, 273.

Genus ? ALBERSIA H. Adams, 1865.

Albersia H. Ad., P. Z. S., 1865, p. 410, type *H. granulata* Q. & G.—v. Martens, Ostasiat. Zool., Landschn. p. 329, 1867.—Tap. Can., Ann. Mus. Civ. Genov. xix, p. 185, 1883.—Pilsbry, Manual vii, p. 89.

Shell globose, thin; aperture but slightly oblique, the peristome hardly thickened, narrowly reflexed; columellar margin rather steeply ascending, narrowed below. Unicolored or banded, never brilliantly colored, the surface dull, granulated or hairy. Type *A. granulata*, pl. 41, fig. 30.

External anatomy and genitalia unknown.

Jaw arcuate, solid, with 6 strong ribs, denticulating the margins, and grouped on the median part of the jaw, the ends free from ribs —(pl. 34, fig. 8, *A. zonulata*). The jaw of *A. pubicepa* also is stated by von Martens to be ribbed.

Radula as in *Chloritis*, etc.; the central and inner lateral teeth having a single cusp shorter than the basal plates, the side cusps represented by slight lateral extensions of the central cusp. Outer laterals having a long, oblique cusp, which becomes bifid on the marginals (mesocone+entocone), and on the outer teeth a small ectocone appears (pl. 34, fig. 9, *A. zonulata*).

This group should perhaps be considered a subgenus of *Chloritis*, but it differs in the thin, capacious form of the shell and the Cochlostyla-like columella. No just estimate of the rank or position of the group can be made until the soft anatomy is investigated. The jaw and teeth offer no differences from those of *Chloritis*, *Thersites*, etc. Distribution, New Guinea and Moluccas.

A. granulata Q. & G., vii, 90.
A. pubicepa v. Mart., vii, 90.
tortistylis Mouss.
A. pseudocorasia Strub., viii, 293.
A. zonulata Fér., vii, 91.
lemniscata Less.
v. recluziana Le Guill.
A. tenuis Pfr., vii, 91.

Genus THERSITES Pfr., 1855.

Thersites Pfr., 1855, plus *Hadra* Alb., 1860, plus *Badistes* Gld., 1862, plus *Sphærospira* Mörch, 1867, plus *Xanthomelon* v. Mart., 1860, plus *Rhagada* Alb., 1860, plus *Glyptorhagada* Pils., 1890.

Shell narrowly umbilicate or imperforate, varying from globular to trochoidal or thick lens-shaped and keeled, usually solid. Whorls 5 or 6, the *apex smooth, never granulated or punctate in regular quincunx;* last whorl varying from smooth to rudely wrinkled, generally densely granulated or roughened microscopically, but *never bearing spaced hairs or hair-scars in regular oblique series.* Aperture moderately oblique, the outer lip expanded (except in *Glyptorhagada*), basal lip reflexed, dilated at the columellar insertion, the ends of the lip rather remote. Type *T. richmondiana*, pl. 29, fig. 8. (See also all figures on pl. 27).

Animal having the general features of that of *Camœna*, *Chloritis*, etc.; the sole undivided and without grooves above its margin; back with one or few grooves from mantle to head; sides irregularly

tuberculate; tail with a slight median longitudinal groove above (pl. 33 figs. 6, 7. *T. gulosa* Gld.).

Jaw arcuate, stout, with 5 to 12 unequal, strong ribs (pl. 32, figs. 47, 48, 50). Teeth having the side cusps of centrals and inner laterals completely fused with the middle cusps; marginals having a long bifid inner cusp (entocone *plus* mesocone) and a simple or bifid ectocone (pl. 34, fig. 1, *T. mitchellæ*).

Genital system having no accessory organs on the female side, the duct of the spermatheca generally long and swollen below. Penis enlarged distally, where its cavity contains a solid papilla; epiphallus bearing the retractor, and terminating at the entrance of the vas deferens in a short flagellum (pl. 33, fig. 1, *Thersites. richmondiana*, and figs. 2, 3, *T. mitchellæ*. Pl. 51, fig. 10, *T. solorensis*). In some species the epiphallus is shortened and the flagellum very short or absent by degeneration (pl. 32, fig. 52, *T. pachystyla*, and fig. 51, *T. rainbirdi*).

Habits strictly terrestrial. With the exception of a few New Guinea species, and some inhabiting the Timor group, the species of this genus are confined to Australia, where they are generally diffused, everywhere constituting the most prominent feature in the Helix fauna.

The various sections assembled under the generic term *Thersites* form a very homogeneous group, the extreme forms being well connected by a chain of intermediate species, *Xanthomelon* and *Rhagada* forming outlying or satellite groups of slightly greater systematic value than the other sections, but still intimately allied. The shell varies from thin, light forms like *corneovirens* through a series of transition species to the solid, richly dyed *blomfieldi*, *mitchellæ* and *bipartita;* and by other chains of almost unbroken continuity, the globose forms are connected with the keeled *richmondiana* and *kooringensis*. The soft anatomy fully sustains these conclusions.

The genus *Thersites* is allied to *Chloritis*, and might without any great violence be united to that genus; but it will probably prove an aid to clear and correct thinking to retain the two separate. *Thersites* never has the depressed earlier whorls, or quincuncially arranged hairs or spaced points so characteristic of *Chloritis*, and the flagellum is shorter or obsolete.

The distribution of the *Thersites* and *Chloritis* groups seems to indicate a hypothesis of two separate times of connection between Australia and the Papuan tract since the beginning of the Tertiary.

The first may have been eocene, at which time the Australian land snail fauna received the ancestors of *Thersites* (+*Hadra*, etc.), and of *Panda*, *Pedinogyra*, etc. At this time the *Hadra* group was not differentiated from *Chloritis*. Subsequent isolation of Australia resulted in the spread of the *Hadra* group and its segregation into the modern subgenera; and during this interval the genera *Thersites* and *Chloritis* were differentiated, the one in Australia, the other in Papua. It is probable that much of the differentiation of *Planispira* and *Papuina*, which are so intimately allied to *Thersites* and *Chloritis*, occurred now, although the bases of these branches may strike still deeper. At all events, they seem to have peopled New Guinea during this interval. The second connection of Queensland with Papua was comparatively recent, although remote enough to allow specific differentiation (see Hedley in *The Nautilus*, March, 1893, p. 124), and at this time, as Hedley believes, the *Chloritis* species invaded Queensland from the north, with *Papuina*, *Atopos* and the land operculates. At the same time Queensland gave to New Guinea its few species of *Thersites* (*Sphærospira broadbenti*, etc.), and perhaps some other forms.

THERSITES *vs.* HADRA. The present group as a whole has hitherto been known as *Hadra* Alb. (See v. Martens, Die Heliceen; Semper, Reisen; Hedley, Proc. Roy. Soc. Q. and P. L. S., N. S. Wales; Pilsbry, Man. Conch.), but the name *Thersites* has priority of five years over *Hadra*. It has also prior position in Die Heliceen, where it is diagnosed and restricted. In view of these facts, and of the further consideration that the nomenclature of Helices is now in a transition stage, we cannot refuse to follow the course indicated by established rules of nomenclature. There is another bar to the use of *Hadra* in a generic sense; it is preceded in the pages of Die Heliceen by *Rhagada*, and this would give the latter name priority, for there can be no doubt that both belong to one genus.

It is now obvious that the use of the name *Hadra* by German writers on shells of China and Japan is founded upon a misconception of their relationships. Part of the "*Hadra*" species of these authors belong to *Camœna*, part to *Euhadra*, a group closely allied to *Campylæa*, etc.

The subdivisions of *Thersites* are not very well defined naturally, but the following may be admitted:

Subgenus THERSITES, in which the shell has rather a conoidal spire and is yellowish or brown, generally banded, the spermatheca

having a long duct; containing sections *Thersites, Glyptorhagada, Badistes, Sphærospira, Hadra.*

Subgenus RHAGADA, with small, depressed globose shell, calcareous in texture and white or whitish, often multilineate; the anatomy as in the preceding.

Subgenus XANTHOMELON, with a globular shell with wide columellar lip, the spermatheca duct short.

Subgenus THERSITES Pfr.

Section *Thersites* Pfr. (restricted).

Thersites PFR. (in part), Mal. Blätter ii, p. 141 (1855 or 1856).—v. MARTENS in Alb., Die Hel. p. 157, type *H. richmondiana.*—PILSBRY, Man. Conch. vi, p. 90.—*Cf.* HEDLEY, Proc. Roy. Soc. Queens. v, p. 62, and vi, 1889, p. 62, pl. 3 (anatomy). Not *Thersites* Spence Bate 1857 (Amphipoda), nor Pagenstecher 1861 (Entomostraca).

Shell *lens-shaped or trochiform*, imperforate when adult, *carinated at the periphery*, more or less pinched at the keel, the last whorl descending in front. *Aperture sub-triangular*, oblique, the outer lip expanded, sinuous above the outer angle; basal and columellar lips reflexed. Type *T. richmondiana* Pfr., pl. 29, fig. 8.

Animal externally like *Sphærospira.* Jaw strongly arcuate, with slightly attenuated, blunt ends, sculptured with about 11 flat ribs, broader than their interspaces, and denticulating the cutting margin (pl. 34, fig. 7, *T. richmondiana*). Radula as in *Sphærospira.*

Genitalia (pl. 33, fig. 1, *T. richmondiana*) as in *Sphærospira mitchellæ*, etc. The penis is short and dilated distally, evidently for the accommodation of an internal papilla. Epiphallus long, bearing the retractor at its middle, terminating in a short flagellum. Duct of spermatheca very long, its lower portion large and swollen.

As will be seen by the figures, the anatomy of *Thersites richmondiana* offers no departure of more than specific value from that of *Sphærospira mitchellæ* and its allies. The group is simply a keeled form of *Hadra*, really not more different from the normal Hadras than *Polygyra (Stenotrema) spinosa* is from *P. stenotrema*, or than *Chloræa thersites* is from *C. sirena.* The development of a keel is now universally acknowledged to be a character of very slight systematic value in the Helices,—too slight in most cases to be held of more than specific importance. Scores of sectional groups contain both rounded and keeled species. The true relationships of *Thersites*

were perceived simultaneously and independently by Charles Hedley and the writer. Our knowledge of the anatomy is due to Hedley.

The name *Thersites* being anterior in date to *Hadra*, will replace that term as a generic designation for the entire series. The same name has been used in Crustacea and Insecta, but later than Pfeiffer's application of it to the present group.

T. richmondiana Pfr. vi, 90. Queensland, northern N. S. Wales.
f. decolorata Pils. vi, 91.

T. novæhollandiæ Gray, vi, 91. New South Wales, Australia, *depuyana* Pfr.

Section *Glyptorhagada* Pilsbry, 1890.

Glyptorhagada PILS., Man. Conch. vi, p. 191 (Dec. 16, 1890).

Depressed, keeled *Badistes*, having the surface corrugated by strong oblique fold-like wrinkles, the outer lip hardly expanded; texture calcareous. Type *H. silveri*, pl. 27, fig. 19. (See also *H. kooringensis*, pl. 27, figs. 7, 8, 9, 10).

This is the South Australian expression of the *Badistes* type; the rudely sculptured, earthy shell responding to the arid condition prevailing in the interior of South Australia, in accordance to the well known law governing the modification of desert snails. The anatomy is unknown. The species were formerly grouped in *Rhagada*, but their affinities are evidently with *Badistes*.

H. silveri Angas, vi, 191. H. bordaensis Ang., vi, 192.
H. kooringensis Angas, vi, 191. H. howardi Ang., iv, 52.

Section *Badistes* Gould, 1862.

Badistes GLD., Otia Conch. p. 243, type *H. gulosa* Gld.—PILSBRY, Man. Conch., vi, p. 94, 129.—For anatomy see HEDLEY, Rec. Austr. Mus., i, p. 196, pl. 29, 1891.

Shell generally smaller and thinner than that of *Sphærospira*, *the surface densely microscopically granulated all over*; often with a peripheral keel. Peristome a little thickened and *very narrowly* expanded, suddenly dilated at the columellar insertion, closing or almost closing the narrow umbilicus. Type *T. gulosa*, pl. 27, fig. 5 (see also pl. 27, fig. 3, *T. bitæniata*).

The animal has a slight groove on each side, running from lips upward and backward to mantle; back with a median furrow banded by two rugæ or sets of rugæ, on each side of which there are about six

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ranks of long, narrow tubercles. The rest of the body is covered with irregular polygonal tubercles which are usually partially subdivided into minor tubercles; those on the tail being small, round and entire. There is a small triangular right mantle lappet, and apparently, a long left lappet, which emits two small lobes on the left side at the origin of the left facial (lateral) groove (pl. 33, figs. 6, 7, living animal of *T. gulosa*, after Hedley).

Jaw arched, crossed asymmetrically by 9 stout, flat-topped unequal ribs, denticulating both margins; ends smooth (pl. 33, fig. 5, *T. gulosa*).

Radula (of *T. gulosa*) having 180 rows of 39·18·1·18·39 teeth. Central and inner lateral teeth unicuspid; outer laterals oblique; marginals with a long, oblique bifid inner cusp (ento-+meso-cone) and a small ectocone.

Genitalia (pl. 33, fig. 4, *T. gulosa*, after Hedley), having the penis twisted and swollen near its apex; retractor inserted low on the epiphallus, which bears a flagellum at the insertion of the vas deferens. Duct of the spermatheca long, inserted high on the vagina.

In soft anatomy and dentition, *Badistes* offers no variation from the type prevailing in *Sphærospira*, *Thersites* or *Chloritis*. In distribution it is more southern than *Sphærospira*, occurring mainly in New South Wales, Victoria and South Australia. The species are highly polymorphic, and have evidently been moulded by external conditions into a great number of local forms. There are more than enough specific names, the only difficulty being which and how many to discard. The reduction of species in the following list is mainly made by the advice of Messrs Cox, Hedley and Brazier. *Conf.* Brazier, Proc. Linn. Soc. N. S. Wales (2), vi, p. 321.

Gould supposed that *Helix gulosa* travelled like the caterpillar of a geometric moth, by a series of loops; but this has been shown to be an error, probably caused by some confusion in the collector's notes.

(*Group of gulosa.*)

T. duralensis Cox, vi, 141.
T. daintreei Braz., vi, 134.
T. patruelis Ang., vi, 131.
T. dunkiensis Forbes, iii, 215.
T. læsa Rve., iii, 214.
T. pliculosa Pfr., iii, 216.
T. expeditionis Cox, iii, 214.
T. corneovirens Pfr., vi, 136.
v. mulgoæ Cox, vi, 136.

T. gulosa Gould, vi, 131.
lessoni Pfr., not auct. viii, 281.
coriaria Pfr., vi, 132.
morosa Morel., vi, 134.
monacha Pfr., vi, 133.
mastersi Cox, vi, 133.
scotti Cox, vi, 133.
? *cailleti* Crs., iii, 216.
T. jervisensis Q. & G., vi, 141; viii, 281.
gilberti Pfr., vi, 142.
grayi Pfr., vi, 130.
exocarpi Cox, vi, 139.
bednalli Braz., vi, 130.
? *sutilosa* Fér.
T. greenhilli Cox, vi, 138.
T. liverpoolensis Braz., vi, 141.
T. marcescens Cox, vi, 142.
T. (?) subgranosa Le Guill. vi, 137.
T. (?) plethorica Crse., vi, 138.
T. leucocheilus Cox, vi, 139.
mariæ Cox, preoc.
T. lismorensis Pils., vi, 140.
T. bellengerensis Cox, vi, 140.
T. yatalaensis Cox, vi, 140.
T. evandaleana Pfr., vi, 142.
T. tomsetti Tate, vi, 143.
T. lincolnensis Pfr., vi, 144.
T. luteofusca Cox, vi, 144.

(*Group of bitæniata, South, Central and Western Australia*).

T. perinflata Pfr., viii, 282.
T. bitæniata Cox, vi, 144.
flindersi Ad. & Ang.
T. lorioliana Crosse, vi, 145.
T. broughami Ang., vi, 146.
T. rufofasciata Braz., vi, 146.
T. sublorioliana Pils., vi, 147.
T. cassandra Pfr., vi, 147.
T. stutchburyi Pfr., vi, 148.
T. bourkensis E. A. Sm., vi, 308.
T. angasiana Pfr., vi, 180.
T. nullarborica Tate, vi, 181.
T. fodinalis Tate, viii, 277.
T. everardensis Bedn., viii, 277.
T. elderi Bedn., viii, 278.
T. oscarensis Cox, viii, 279.
T. derbyi Cox, viii, 280.
T. forrestiana Ang., vi, 182.

Section *Hadra* Albers, 1860.

Hadra Alb., Die Hel. (edit. Martens), p. 165, type *H. bipartita*. —*Cf.* Semper, Reisen, etc., pl. 17, f. 16, dentition of *H. bipartita*.

Shell depressed with conoidal spire, narrowly umbilicated, obliquely striate or hirsute; unicolored, or brown below, yellow above, never having many bands; peristome expanded. Type *T. bipartita* Fér.

Dentition (of *T. bipartita*, pl. 32, fig. 49) similar to that of *Sphærospira*, etc.; the central and lateral teeth unicuspid, marginals with an ectocone. The figure shows a central with one adjacent lateral tooth, and the 47th side tooth.

Hadra, as restricted, consists of a few north Queensland species, differing somewhat from Sphærospira in shell characters.

T. bipartita Fér., vi, 126.
semibadia Alb.
f. unicolor Cox, viii, 276.
f. minor, vi, 126.
Var. semicastanea Pfr., vi, 126.
funiculata Pfr.
T. forsteriana Pfr., vi, 127.
hetæra Pfr.
f. major Dohrn, vi, 128.
T. darwini Braz., vi, 128.

Section *Sphærospira* Mörch.

Sphærospira MOERCH, Journ. de Conchyl., 1867, p. 256, for *H. fraseri, lessoni, appendiculata.*—For anatomy, see SEMPER, Reisen, p. 160, pl. 14, f. 11 (*basalis*), and HEDLEY, Proc. Roy. Soc. Queensl. vi, pl. 7, 8 (*fraseri, blomfieldi, rainbirdi*), and Proc. Linn. Soc. N. S. W. (2), vi, pl. 39, 41, 42 (*broadbenti*).

Shell globose, solid, yellowish, with brown spiral lines and bands or uniform chocolate-brown by coalescence of the bands; spire elevated, somewhat dome-shaped; surface smooth to the naked eye. Peristome broadly expanded. Type *H. fraseri.* (See pl. 27, fig. 4, *T. blomfieldi* var. *warroensis* Hedl. Pl. 27, figs. 1, 2, *T. rawnesleyi* Cox).

Animal having the sole indistinctly tripartite; edges of foot without a foot border; sides irregularly granulated; tail convex above, with an inconspicuous longitudinal impressed line; back from mantle to head with several longitudinal grooves. Mantle bearing a small triangular right body lappet and a minute left lappet. (*Mitchellæ*).

Jaw arcuate, strong, sculptured with broad, rather flattened ribs, usually 6 to 8 in number, strongly denticulating the cutting margin. (Pl. 32, fig. 48, *T. blomfieldi.* Pl. 34, fig. 2, *T. mitchellæ.* Pl. 32, fig. 50, *T. rainbirdi*). The jaw of *broadbenti* has 11 ribs.

Radula having the central tooth smaller than the adjacent laterals; central and lateral teeth unicuspid, the side cusps represented by a lateral continuation of the reflection, being completely fused with the median cusp. Transition teeth and inner marginals having a long bifid inner cusp (entocone+mesocone) and a simple, small ectocone. Outer laterals tricuspid (in *fraseri, yulei, lessoni, blomfieldi*) or quadricuspid by splitting of the ectocone (*incei, mitchellæ*, pl. 34, fig. 1.)

Genitalia lacking all accessory organs on the female side, the duct of the spermatheca very long (pl. 33, fig. 3, *s, s, s*), its upper portion narrow, lower portion stout or swollen. Penis large, club-

shaped, the walls of its cavity granulated, having a large solid, granulated papilla at the apex, near the entrance of the epiphallus (pl. 33, fig. 3, papilla indicated by dotted line). Epiphallus long, the penis retractor inserted at the proximal third of its length; ending in a flagellum. Penis retractor short, attached to floor of the lung cavity. Right eye-peduncle retracted between primary branches of genitalia. Pl. 33, figs. 2, 3, *H. mitchellæ;* fig. 2, reverse view of vagina, showing lower course of uterus and vas deferens. (From a specimen received from Dr. Cox).

T. mitchellæ and *broadbenti* have the type of genitalia described above, but in the latter the spermatheca has a shorter stalk. A second type of genitalia is found in *T. basalis* (=*rainbirdi*), *T. fraseri*, *T. blomfieldi* in which species the epiphallus is extremely short and the flagellum either extremely short or obsolete, evidently by degeneration. Only by opening the penis can the true condition of these organs be ascertained. (See pl. 32, fig. 51, *T. rainbirdi*, after Hedley).

In anatomy, *Sphærospira* agrees with *Badistes* and *Thersites*, except that in some species the appendages of the penis have undergone degeneration resulting in secondary haplogonism. The group inhabits Queensland with a few forms in New Guinea, being replaced southward by *Badistes*, westward by *Xanthomelon*.

Most of the species of *Sphærospira* live under the loose bark of fallen trees and on the ground, and are gregarious. Some occur under stones in damp places. *No Hadras are arboreal*, according to Hedley; differing totally in this respect from *Papuina*, but agreeing with *Chloritis*.

(*Imperforate species*).

T. fraseri Gray, vi, 150.
v. flavescens Hedl., vi, 151.
T. coarctata Fér., vi, 151.
T. zebina Braz., vi, 151.
T. mossmani Braz., vi, 152.
T. coxi Crosse, vi, 152.
forbesi Cox, preoc.
cerea Cox, preoc.
cerata Cox.
T. croftoni Cox, vi, 153.
T. blomfieldi Cox, vi, 154.
v. warroensis Hedl. & Mouss., [viii, 281.
T. mitchellæ Cox, vi, 154.
T. gratiosa Cox., vi, 155.
T. etheridgei Braz., vi, 156.
T. macleayi Cox, vi, 156.
T. andersoni Cox, vi, 157.

(*Umbilicated species*).

T. rainbirdi Cox, vi, 157.
basalis Mouss.
T. rawnesleyi Cox, viii, 282.
T. barneyi Cox, vi, 165.

T. oconnellensis Cox, vi, 158.
albofilata Mouss.
T. arthuriana Cox, vi, 159.
T. rockhamptonensis Cox., vi, *planibasis* Cox, *ms.* [159.
v. moresbyi Ang., vi, 160.
v. pallida Hedl. & Mss. viii, 281.
T. informis Mouss., viii, 282.
T. palmensis Braz., vi, 160.
v. meridionalis Braz., vi, 161.
T. bellendenkerensis Braz., vi, [161.
T. parsoni Cox, vi, 162.
T. appendiculata Pfr., vi, 163.
T. seminigra Morel., vi, 162.
lessoni Pfr., olim., et auct.
? =incei var.
T. incei Pfr., vi, 166.
v. aureedensis Braz., viii, 282.
v. bayensis Braz., vi, 166; viii, [282.
T. thatcheri Cox, vi, 164.
T. hilli Brazier, vi, 164.
T. mazee Braz., vi, 165.
T. hanni Braz., vi, 166.
T. prætermissi Cox, vi, 167.
T. mulgravensis Braz., vi, 168.
mulgravei Braz.
T. curtisiana Pfr., vi, 168.
bala Braz., vi, 169.
T. johnstonei Braz., vi, 170.
T. creedi Cox, vi, 170.
T. wesselensis Cox, vi, 170.
T. sardalabiata Cox, vi, 171.
stephensoniana Braz.
T. whartoni Cox, vi, 171.
T. mourilyana Braz., vi, 172.
T. yulei Forbes, vi, 172.
T. challisi Cox, vi, 173.
T. nicomede Braz., vi, 173.
T. beddomæ Braz., vi, 174.
T. bebias Braz., vi, 175.
T. cookensis Braz., vi, 175.
T. tomsoni Braz., vi, 175.
T. broadbenti Braz., vi, 176.
T. hixoni Braz., vi, 177.

Subgenus Xanthomelon v. Martens, 1860.

Xanthomelon Mts., in Alb., Die Hel., p. 174, type *H. pomum*; Mal. Blätter xvi, p. 77, 1869.—Pils., Man. Conch., vi, p. 178.—For anatomy, see Semper, Reisen, p. 160, pl. 14, and Hedley, P. R. S. Q., vi, p. 250, pl. 14, and p. 121, pl. 8.

Shell large, solid and *globular*, the spire small, body-whorl large, globose, descending to the aperture, which is semioval and somewhat oblique. Peristome narrowly expanded, thickened within; columellar lip broad, flattened, partly or wholly covering the axial perforation; surface somewhat roughened, covered with a yellow cuticle. Type *T. pomum*, pl. 27, fig. 6.

Jaw stout, arched, with 8 (*perinflata*) to a dozen (*pachystyla*) stout ribs, obsolete toward the ends (pl. 32, fig. 47, *pachystyla*).

Radula as in *Sphærospira* etc. (pl. 32, fig. 46, *pachystyla*).

Genital system having the penis rather short and stout, twisted at its apex, where the retractor-muscle and vas deferens are apparently

inserted. Spermatheca duct short and arising high on the vagina (pl. 32, fig. 52, *pachystyla*).

The shell is more globular than that of *Hadra s. str.* or *Sphærospira*, with smaller spire and wider columellar lip. The jaw and teeth are not different from those of *Sphærospira*, etc. The peculiarity of the genital system is the apparent obsolescence of the epiphallus and flagellum, and the shortness of the duct of the spermatheca, which is, as a general rule, long in this genus and its allies. Semper has investigated the anatomy of *pachystyla*, and Hedley that of *pachystyla* and *perinflata*. The penis should be reexamined, with a view to finding traces of the missing epiphallus and flagellum, and the internal papilla.

The species inhabit Queensland, Arnhem land and the adjacent parts of the northern territory of S. Australia. *T. pachystyla* is found on sandy ridges buried a few inches below the surface among the roots of bushes, in dry weather.

T. pomum Pfr., vi, 178.
urvillei H. & J.
pseudomeadei Braz.
? *sphæroidea* Le Guill.

T. nigrilabris v. Mts., vi, 179.
edwardsi Cox not Bld.
meadei Braz.

T. banneri MacGill. vi, 179.

T. lyndi Angas, vi, 183.

T. pachystyla Pfr. vi, 184.
v. daemeli v. Mts. vi, 184.

T. jannellei Le Guill, vi, 182.
pachystyloides Cox.

Subgenus Rhagada Albers, 1860.

Rhagada Alb., Die Hel., 1860, p. 108, type *H. reinga* Gray. Pilsbry, Man. Conch., vi, p. 184.—Wiegmann, Weber's Zool. Ergebnisse einer Reise in Niederl. Ost-Ind. iii, p. 169 (anatomy).

Shell small, compact, globose-depressed, narrowly or covered umbilicated, rather solid and cretaceous, whitish, unicolored or multilineate with reddish, the supraperipheral band most prominent and constant; periphery rounded; outer lip more or less expanded and thickened, columella reflexed, partly or wholly closing the umbilicus. Type *T. reinga* Gray. (see pl. 27, figs. 16, 17, 18, *T. carcharias* Pfr. Pl. 27, figs. 11, 12, 13, *T. supracostulata* Schepm. Pl. 27, figs. 14, 15, *T. floresiana* Martens).

Jaw (pl. 51, figs. 7, 8, *T. solorensis*) arcuate, with 4 or 5 unequal and asymmetrically arranged strong ribs.

Radula (pl. 51, figs. 11, 12, *T. solorensis*) with 126–163 transverse rows of 31. 1. 31 to 38. 1. 38 teeth of the type usual in *Chloritis* and

Hadra. Central and inner lateral teeth having the ecto- and ento-cones completely fused with the mesocones, which attain or project beyond the posterior edges of the basal-plates. Outer laterals hav-side side cusps developed, the meso- and ento-cones forming a long compound cusp as in *Chloritis*, etc. Marginal teeth (fig. 11) tricuspid, or having the ectocones bifid (figs. 11, 12 show central with two adjacent laterals, 10th to 13th lateral and transition teeth, 22d, 23d and 32d to 35th marginal teeth; after Wiegmann. Pl. 51, fig. 9, shows a central and lateral tooth from another individual, in which the ectocones are developed). In *T. convicta* the jaw has 7 stout ribs, dentition as in *solorensis* (See Binney, Dent. Pulm. Moll. pl. x, f. G.)

Genitalia (pl. 51, fig. 10, *T. solorensis*, after a drawing by Mr. A. Protz) with a short flagellum on the penis, the spermatheca-duct inserted high on the vagina. No penis retractor is shown in the sketch, but it is probably present; and it is likewise probable that the penis proper terminates with the swollen portion seen at about the middle of its length, and that it contains a papilla there; the narrower upper part, as far as the entrance of the vas deferens, being an epiphallus.

The snails of this section have a smaller, more compact and cretaceous shell than *Hadra*, with a different scheme of color. The anatomy offers no deviation of any importance from that of *Hadra* and *Chloritis*.

(*Species of N. Australian coast and adjacent islands*).

T. reinga Gray, vi, 185.
T. richardsonii E. A. Sm., vi, 185.
T. leptogramma Pfr., vi, 186.
T. dringi Pfr., vi, 186.
T. tescorum Bens., vi, 187.
T. elachystoma v. Mts., vi, 187.
T. convicta Cox, vi, 187.
T. plectilis Bens., vi, 188.
paleata Rve.
T. carcharias Pfr., vi, 189.
T. (?) torulus Fér. vi, 189.

(*Species of Solor, Flores, and other islands N. of Timor Sea*).

T. colona v. Mts., vi, 190.
T. solorensis v. Mts., vi, 190.
T. floresiana v. Mts., pl. 27, f. 14, 15.
T. supracostulata Schep., viii, 283.

Genus PAPUINA von Martens, 1860.

Papuina Mts., Die Hel. (2d edit.), p. 166, type *H. lituus* Less.—Pilsbry, Man. Conch., (2), vii, p. 3.—*Eugenia* Alb. Mss.—*Insu-*

laria Tap. Can. Ann. Mus. Civ. Genov. xix, p. 115, 138, type *H. lituus*, 1883. *Pileolus* Lesson, Voy. de la Coquille. Zool. ii, p. 313 (preoc.).—*Cymotropis* v. Mart., Die Hel., p. 169, type *H. "vitrea"* = *antrorsa*.—*Merope* Alb., Die Hel., 2d edit., p. 158, type *H. fringilla* (preoc.).—*Geotrochus* of Beck and authors, not of v. Hasselt.—*Acavus* Smith and Tap. Can., not of Montf.

Shell turbinate, lens-shaped or trochiform, umbilicated or imperforate, rather thin; periphery varying from round to acutely keeled. Surface smoothish, the coloring light or bright. Aperture oblique, toothless or with a columellar nodule, the peristome thin and generally expanded, ends of the lip remote. Type *P. lituus* Less. pl. 29, fig. 12 (see also pl. 29, figs. 14, 15, *P. trobriandensis*. Fig. 11, *P. splendescens*. Fig. 13, *P. nortoni*. Pl. 46, figs. 17–19, *P. ianthe*).

Animal with the foot rather short, sole undivided; upper surface densely granulated, with a slight median longitudinal groove above, the tail densely granulose with no median groove. Mantle with a triangular right lappet and an elongated low left one, the latter emitting a lobe on the left side.

Jaw *thin and weak*, arcuate, *its median portion ribbed*, ends blunt and ribless. (Pl. 34, fig. 11, *P. moseleyi*. Pl. 34, fig. 12, *P. vexillaris*. Pl. 37, fig. 2, *P. conscendens*. Pl. 13, fig. 17, *P. grata*. Pl. 13, fig. 18, *P. taumantias*. Pl. 13, fig. 25, *P. louisiadensis*. Pl. 13, fig. 24, *P. boyeri*. Pl. 13, fig. 26, *P. brumeriensis*. Pl. 13, fig. 28, *P. macgillivrayi*.

Radula of two types. Typically, the transverse rows are nearly straight; the central and lateral teeth with wide, blunt mesocones, shorter than the basal plates, the marginals with three short, wide cusps (pl. 13, fig. 23, *boyeri*. Pl. 13, fig. 29, *fringilla*. Pl. 37, fig. 11, *conscendens*). In *P. moseleyi* (pl. 37, fig. 1) the cusps are very broad, and project beyond the basal plates.

In some divergent species *the transverse rows of teeth are* v-*shaped;* central teeth (pl. 37, fig. 9), with an extremely broad, gouge-like cusp (united meso- and ectocones), the laterals having the cusp partially divided into entocone and mesocone, an ectocone appearing on the outer laterals and marginals. The teeth are all of the same general form, and in all the cusps project over the basal plates. This type of teeth occurs in *P. boivini* and in *vexillaris* (pl. 37, figs. 9, 10), and will probably prove characteristic of the groups those species belong to, and also of the *P. meta* group; the other groups having the more normal type of teeth. This aberrant type is com-

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parable to that of *Polymita* and *Oxychona*, and seems to be correlated with arboreal habits. *P. moseleyi* bridges, to some extent, the gap between the two types of teeth.

Genital system having no accessory organs on the female side, the spermatheca on a rather long duct. Penis containing a papilla at its apex, continued in a long epiphallus which bears the retractor, and which passes into the vas deferens, having no flagellum or merely the rudiment of one. (Pl. 37, fig. 5, *P. trobriandensis*; pl. 37, figs. 3, 4, *P. vexillaris*; pl. 37, figs. 7, 8, *P. fringilla*; pl. 13, fig. 16, *P. grata*; pl. 13, fig. 21, *P. yulensis*; pl. 13, fig. 27, *P. brumeriensis*).

In another series of species the penis is short, the epiphallus very short, hardly distinguishable, ending in a short flagellum (pl. 13, fig. 22, *P. taumantias*; pl. 37, fig. 6, *P. brazieri*). Some of these have the spermatheca duct very short.

The prominent features of the anatomy are the weakness of the thin jaw, the breadth of the cusps of the teeth, and the lack of a flagellum upon the epiphallus, or its shortness, the union of epiphallus and vas deferens being indicated only by a slight protuberance at the end of the former, in most species.

In some species (*trobriandensis, woodlarkiana, moseleyi*) the penis is extremely small. In others (*boyeri, louisiadensis, fringilla*) it is large and muscular. In one group of forms, *taumantias, brazierœ, tomasinelliana, gestroi, meditata, ridibunda*, the epiphallus is reduced to a very short extent, or even obsolete, and a short flagellum is developed. There is, therefore, a wide range of variation in the soft parts, as in the shells, of this genus.

In *P. fringilla* the papilla is extremely long, and the walls of the penis cavity are transversely corrugated (pl. 37, fig. 7). In *P. vexillaris* the papilla is large but short (pl. 37, fig. 4). The eyestalk is retracted between the branches of the genitalia, as usual. In *P. fringilla* the left edge of the mantle bears a lobe, at the position where two lobes are shown in *Thersites* (*Badistes*) *gulosa*.

The anatomy of many forms is now known: Binney has figured the teeth of *P. fringilla* (Ann. N. Y. Acad. III, p. 113). Tapparone Canefri has figured the genitalia of *P. yulensis, katauensis, taumantias, ridibunda, meditata, grata, novoguineensis, brazierœ, gestroi, tomasinelliana* (Ann. Mus. Civ. Genov. xix, pl. 6 and 7). Hedley has illustrated the anatomy of *P. brumeriensis, louisiadensis, rollsiana, woodlarkiana, trobriandensis*, and *boyeri* (Proc. Linn. Soc. N. S. Wales (2), vi, pl. 38–42. Pfeffer has figured the anatomy of *P.*

boivini (Monatsber. Berl. Akad. Wissensch. 1877, p. 277, pl. 2, f. 11–13). The writer has examined the soft parts of *P. fringilla, vexillaris, moseleyi* and *conscendens.*

Papuina is an exclusively arboreal genus, being strongly contrasted in this habit to its allies *Thersites* and *Chloritis.* The shell is of lighter structure and brighter color than in these terrestrial groups, somewhat approaching that of *Cochlostyla*—a case of convergence of external characters from similar habits. The teeth differ from those of allied groups, Thersites, Chloritis, Planispira, in *the great breadth and bluntness of the cusps,* a structure correlated with arboreal habits. The jaw is more delicate than in the allied genera.

The great variation observed in the genitalia and teeth of the species examined, shows that here lies a wide field for future cultivation. These features are no doubt characteristic of minor groups in the genus, and their investigation will lead to valuable results in the classification of the group, and secondarily may be of use in the study of its geographical distribution and migrations. The arboreal habit has evidently been long established, for otherwise we should not have so profound a remodeling of the dentition.

The geographic limits of the genus are on the northwest Halmaheira, on the southeast, the New Hebrides group. There are two principal centers of specific radiation: New Guinea and the Solomon archipelago. The former of these has peopled the Moluccas, Queensland and the Louisiades. The species of Java, Sumatra and India referred by authors to this genus belong to other groups, mainly *Satsuma.*

Subdivisions.

Section *Papuina.* Shell having the outer lip well expanded, baso-columellar lip reflexed.

Section *Dendrotrochus.* Shell trochoid, the columellar lip not in the least expanded or reflexed.

Section *Papuina* (restricted).

(*Group of P. boivini;* Solomon and New Britain groups.)

P. congrua Pfr., vii, 4.
P. chancei Cox, vii, 5.
amphizona Pils., vii, 5.
P. hargreavesi Ang. vii, 9.
hargravesi auct.
P. gamelia Ang., vii, 10.

P. boivini Petit, vii, 6.
subrepta H. & J.
colorata Mss.
P. ambrosia Ang., vii, 7.
ramsdeni Ang.
P. malantensis Ang., vii, 7.
P. philomela Ang., vii, 8.
P. guadalcanarensis Cox, vii, 9.
P. brodiei Braz., vii, 10.
P. dampieri Ang., vii, 11.
P. walleri Braz., vii, 12.
brenchleyi Ang., not Braz.
P. alfredi Cox, vii, 12.
v. trichroa v. Mart., vii, 12.
P. macfarlanei Cox, vii, 13.
P. coxiana Ang., vii, 13.

(*Group of P. meta;* Solomon Is.).

P. xanthochila Pfr., vii, 15.
P. miser Cox, vii, 20.
beatrix Ang., vii, 15.
P. choiseulensis Braz., vii, 16.
P. spendescens Cox, vii, 16.
brenchleyi Braz., vii, 16.
mendana Ang., vii, 17.
P. meta Pfr., vii, 17.
deidamia Ang.
v. acmella Pfr., vii, 18.
P. plagiostoma Pfr., vii, 19.
P. guppyi Smith, vii, 19.
P. adonis Angas, vii, 20.
metula Crosse.
P. blanda Cox, vii, 21.
P. mendoza Braz., vii, 21.
P. hermione Ang., vii, 21.
biocheana Crosse.
P. migratoria Pfr. vii, 22.
leucophœa Cox.

(*Group of P. flexilabris*; Solomons, Louisiades and New Ireland).

P. vexillaris Pfr., vii, 46.
phthisica Pfr.
P. boyeri C. & F., vii, 47.
P. phæostoma Mart., vii, 47.
P. gaberti Less., vii, 48.
trochus Q. & G.
trochoides Desh.
P. lambei Pfr., vii, 48.
lombei Pfr., *olim.*
P. flexilabris Pfr., vii, 49.
P. coniformis Fér., vii, 50.
turbinata Desh.
v. tuffetii Less., vii, 51.
P. sellersi Cox, vii, 51.

(*Group of P. conscendens;* Queensland).

"A small group of Queensland snails seem to differ from the main body of the genus in their habits. Not the stem or branches, but the *leaves* of trees are chosen by these for their favorite abode. To suit the situation the shell has been modified until the contour would suggest *Partula* rather than *Papuina.* The more conical shape has probably been adopted for greater safety in the exposed tree tops; to the same end every superfluous atom of weight has

been abandoned, the shell reduced to the thinnest, and the reflected lip dispensed with." (*Hedley, Nautilus, vii, p.* 73).

P. fucata Pfr., vii, 14.
P. conscendens Cox, vii, 14.
P. folicola Hedley, Nautilus, *l. c.*
B. bidwilli Cox not Pfr.

(*Group of P. pileus;* Moluccas and New Guinea).

P. euchroes Pfr., vii, 23.
P. pileus Müll., vii, 24.
pileata, bifasciata, ambigua [Gmel.
P. blainvillei Le Guill, vii, 25.
gärtneriana Pfr.
zoae Pfr.
P. lenta Pfr., vii, 23.
P. canovarii Tap. Can., vii, 26.
P. blanfordiana H. Ad., vii, 26.
blanfordi H. Ad.
turbinata Val., *mss.*
v. poirieri Tap. Can., vii, 27.

(*Group of P. poiretiana;* Night I., N. E. Australia).

P. poiretiana Pfr., vii, 27.

(*Group of P. antiqua;* Borneo ?, New Guinea).

P. antiqua Ad. & Rv., vii, 28.
P. xanthosoma Pils., vii, 28.
P. leonardi Tap. Can., vii, 32.
horderi Sowb., vii, 29.

(*Group of P. pileolus*; Moluccas and western New Guinea).

P. pileolus Fér., vii, 29.
f. turrita v. Mart.
f. pyramidata v. Mart.
f. convexa v. Mart.
f. depressa v. Mart.
P. rhynchostoma Pfr., vii, 30.
P. ferussaci Less., vii, 30.
P. exsultans Tap. Can., vii, 31.
ferussaci Pfr., Novit. Conch.
P. hedleyi Smith, viii, 290.
P. pythonissa Tap. Can., vii, 31.
P. turris H. Ad., vii, 32.
P. fergusoni H. Ad., vii, 32.
P. steursiana Shutt., vii, 33.

(*Group of P. vitrea:* Moluccas and New Guinea).

P. vitrea Fér., vii, 33.
albula Le Guill.
vitracea Beck.
P. arrowensis Le Guill, vii, 34.
P. chondrodes Strub., viii, 292.
P. lanceolata Pfr., vii, 34.
P. grata Mich., vii, 35.
acuta Q. & G., not Lam.
P. leucotropis Pfr., vii, 36.
P. hero Smith, vii, 57.
P. ianthe Smith, vii, 58.
P. nodifera Pfr., vii, 37.
P. pelechystoma Tap. Can.,vii, 35
P. pennantiana Pfr., vii, 36.
P. carinata Hombr. & Jacq.vii, 36.
P. bevani Braz., viii, 292.
P. ? elisus Hedl., viii, p. 292.
P. ? goldiei Braz., vi, 217.
oxystoma Smith (preoc.).
P. ? tritonensis Le Guill., vii, 88.

(*Group of P. labium:* Papuan region).

P. lituus Less., vii, 37.
ardouini Dh.
papuensis Q. &. G.
P. labium Fér., vii, 38.
P. pseudolabium Pfr., vii, 38.
P. multizona Less.. vii, 39.
tenuiradiata Q. & G.
multizonata Desh.
spectrum Rve.
P. taumantias Tap. Can., vii, 39.
v. cingulata Hedl., viii, 288.
P. ridibunda Tap. Can., vii, 40.
P. sicula Braz., vii, 45.
meditata Tap. Can., vii, 40.
P. aurora Pfr., vii, 41.
P. ærope Smith., vii, 41.
P. novoguineensis Pfr. vii, 42.
v. triumphalis Rve, vii, 42.
v. mysolensis Pfr., vii, 43.
P. waighouensis H. Ad., vii, 43.
P. brazieræ Braz., vii, 43.
v. lacteolota Smith, vii, 25.
P. tomasinelliana T. C. vii, 44.
v. anozonata Hedl., viii, 288.
v. agnocheilus Smith, viii, 289.
P. gestroi Tap. Can., vii, 44.
P. maclayana Braz., vii, 45.

(*Group of P. louisiadensis*: Louisiades, d'Entrecasteaux Is., and British New Guinea).

P. tayloriana Ad. & Rv., vii, 58.
yulensis Braz.
P. strabo Braz., vii, 60.
roseolabiata Smith.
katauensis T. C.
P. gorenduensis Braz., vii, 63.
P. rollsiana Smith, vii, 63.
P. comriei Ang., vii, 64.
P. louisiadensis Forbes, vii, 61.
v. millicentæ Cox, vii, 62.
v. thomsoni Smith, vii, 62.
P. gurgustii Cox, vii, 61.
P. rhombostoma Pfr., vii, 60.
P. woodlarkiana Souv., vii, 62.
P. trobriandensis Hedl., viii, 290.
P. albocarinata Smith, vii, 59.

(*Group of P. brumeriensis:* Eastern New Guinea).

P. chapmani Cox, vii, 51.
coraliolabris Smith,
P. brumeriensis Forbes, vii, 52.
v. albolabris Hedl., viii, 289.
P. rangii Less., vii, 53.
extricanda Tap. Can.
P. zeno Braz., vii, 53.
latiaxis Smith.
P. diomedes Bras., vii, 54.
P. naso v. Mart., vii, 56.
tapparonei Smith.
P. rhynchonella Tap. Can., vii, 57.

(*Australian Species*).

P. macgillivrayi Forbes, vii, 55.
P. cerea Hedl.
P. bidwilli, Pfr., vii, 55.
bridwilli Pfr., *olim.*

(*Group of P. eddystonensis*).

P. eddystonensis Reeve, vii, 64.
P. motacilla Pfr., vii, 66.
P. nortoni Braz.
P. cærulescens Ang., vii, 68.

P. gelata Cox, vii, 65.
v. maddocksi Braz., vii, 66.
P. antrorsa Pfr., vii, 67.
vitrea v. Mart., olim.
P. sachalensis Pfr., vii, 67.
P. leucothoe Pfr., vii, 68.
P. pudica Pfr., vii, 69.
P. lienardiana Crosse, vii, 69.
P. eros Angas, vii, 70.
P. redempta Cox, vii, 70.
P. nigrofasciata Pfr., vii, 71.
P. donnaisabellæ Ang., vii, 71.

(*Group of P. moseleyi*).

P. moseleyi Smith, vii, 72.
P. novægeorgiensis Cox, vii, 72.

(*Group of P. fringilla*).

P. fringilla Pfr., vii, 73.
P. barnaclei Smith, vii, 73.

Section DENDROTROCHUS Pilsbry, 1894.

Papuina with the shell imperforate, trochiform, with rhombic aperture, the lip thickened within; *columellar lip not expanded or reflexed.* Type *P. helicinoides* Hombr. & Jacq.

Soft anatomy unknown. Distribution Solomon Is., New Hebrides, Admiralty Is. and New Ireland. They are arboreal in habit. Brazier found *P. cyrene* in hundreds on the under sides of leaves of small bushes, in Ugi, Solomon Is.

This is quite a well characterized section of *Papuina.* According to Hedley the Solomon Islands forms (*cleryi, quirosi, zelina, cyrene*) will prove to be varieties of one species (see Man. Conch., viii, p. 290).

P. labillardierei Smith, vii, 75.
P. helicinoides H. & J., vii, 76.
v. cleryi Recl., vii, 76.
septentrionalis Sm.
v. meridionalis Sm., vii, 77.
v. quirosi Cox, vii, 80.
P. zelina Cox, vii, 78.
P. cineracea H. & J., vii, 77.
cinerarea Rouss.
P. cyrene Crosse, vii, 78.
P. eva Pfr., vii, 78.
P. layardi Hartm., vii, 79.
P. pyxis Hinds, vii, 80.
P. crucibulum Pfr., vii, 81.

Genus PLECTOPYLIS Benson, 1860.

Plectopylis BENS., Ann. and Mag. N. H. (3), v, p. 243.—STOLICZKA, Journ. Asiat. Soc. Beng. xl, (2), p. 217, pl. 15 (anatomy).—GODWIN-AUSTEN, P. Z. S. 1874, p. 608.

Shell depressed, with flat or low-conical spire and large umbilicus, dextral or sinistral; solid or thin, the upper surface generally sculpt-

ured with spiral lines, hirsute in the young. Aperture half-round or lunate, oblique, the lip reflexed, its ends generally joined by an elevated parietal callus, which usually bears an entering lamella. Interior of the last whorl *obstructed by a barrier composed of a transverse plate or plates on the parietal wall*, and several transverse or longitudinal denticles or plates on the outer wall. Type *P. achatina* Gray, pl. 40, figs. 5, 6, 7, 8. (See also pl. 40, figs. 1–4, *P. jovia*. Pl. 40, figs. 9–12, *P. ponsonbyi*. Pl. 40, figs. 13–15, *P. fultoni*).

Foot short, rarely equalling in length the diameter of the shell; tentacles very short; eye pedicles of moderate length. Mantle edge thin, with small right and left body-lappets. Pulmonary cavity small. Kidney large, triangular.

Jaw very thin, horny, arched, with a small anterior median projection; it is marked transversely with a great number of more or less distant grooves which divaricate in the center (pl. 42, fig. 36. *P. cyclaspis*). Radula of moderate width, long, composed of about 100 transverse more or less V-shaped rows of 60–70 teeth. *Central tooth smaller, sometimes much smaller, than the laterals*, very narrow, the reflection small, with three slender cusps. Lateral teeth with a large inner cusp and simple or bifid outer cusp, and a minute inner cusp (pl. 42, fig. 35, *P. cyclaspis* central, 1st, 2d and 12th laterals, and 20th and 25th marginal teeth. In *P. pinacis* the central tooth is larger and more similar to the laterals.

Genital system (pl. 42, fig. 34, *P. cyclaspis*) having the duct of the spermatheca long. An organ of unknown homology (either a dart sack, a diverticulum of the spermatheca, or an appendicula) enters the vagina just above the opening of the spermatheca duct. Uterus containing few large eggs. Penis simple, receiving the vas deferens and the penis retractor at its apex, the latter attached distally to the floor of the lung cavity.

This group differs from *Corilla* in having perpendicular internal lamellæ upon the parietal wall of the shell. It is different from *Corilla* and all other Helices in the converging V like elements of the thin jaw, which is quite of the goniognathous type found in *Cylindrella*, *Orthalicus* and *Otostomus*. The small size of the central teeth is also an anomalous feature, recalling the *Achatinidæ*. Perhaps the accessory organ of the vagina (seen between the uterus and the spermatheca in pl. 42, fig. 34) is really a diverticulum of the spermatheca duct; and if this is the case the genital organs will not differ very much from those of *Corilla*, although in that genus the

retractor of the penis is attached to the uterus wall (as in *Hyalosagda*) instead of to the lung floor.

The apex of the shell is rather large, as in *Corilla*, and usually somewhat rugose. The grouping of the species is based upon the form of the internal barrier, which is sometimes simple (pl. 40, fig. 4), sometimes excessively complex by the duplication of the parietal and palatal barrier (pl. 40, figs. 7, 8, 12). Godwin-Austen found shells with insects fixed between the teeth, so that there can be little doubt that this barrier has been evolved for the protection of the snail from predatory insects which swarm in the regions these forms inhabit.

P. achatina and *cyclaspis* are found on limestone hills, the animal being shy, usually living in crevices and holes, and closely adhering to the rock, even when moving about.

This genus inhabits India and Farther India, extending north to central China and south to Ceylon and the Philippine Islands.

Subdivisions.

Plectopylis is herein expanded to contain two Chinese groups of uncertain affinities, besides the typical group.

Subgenus PLECTOPYLIS. Whorls regular, the last not distorted nor grooved outside; having internal transverse barriers within the last whorl.

Subgenus TRAUMATOPHORA. Latter part of last whorl contracted outside; throat obstructed by entering palatal lamellæ, but having no internal processes on the parietal wall.

Subgenus STEGODERA. Shell sinistral, the last whorl distorted straightened, embracing the preceding; aperture crescentic, toothless; throat very narrow, but without internal teeth or lamellæ.

Subgenus PLECTOPYLIS Bens.

(*Parietal vertical lamina double or compound*).

P. achatina Gray, iii, 165.
  ? *repercussa* Gld.
P. anguina Gld., iii, 165.
P. brahma G.-Aust. iii, 164.
P. cyclaspis Bens., iii, 164.
  catinus Bens. *olim.*
P. karenorum Blanf., iii, 164.
P. revoluta Pfr., Mon., v, 416.
P. refuga Gld., iii, 164.
P. dextrorsa G.-Aust., iii, 164.
P. leiophis Bens., iii, 163.
P. shiroensis G.-Aust., iii, 163.
P. feddeni Blanf., iii, 163.
P. brachyplecta Bens., iii, 163.
P. biforis Hde., iii, 166.
P. ponsonbyi G. A.

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(*Parietal vertical lamina single*).

P. shanensis Stol., iii, 162.
trilamellaris G.-A.
P. perarcta Blanf., iii, 162.

P. retifera Pfr., iii, 161.
P. clathratula Pfr., iii, 161.
puteolus Bens.
P. fultoni G.-A., viii, 296.

P. laomontana Pfr., iii, 160.
P. schistoptychia Mlldff., iii, 165.
P. diptychia Mlldff., iii, 158.
P. polyptychia Mlldff., J. B. [xiv, 272.
P. trochospira Mlldff. J. B., xiv, [273.

P. schlumbergeri Morl., iii, 166.
P. jovia Mab., viii, 156.
P. villedaryi Anc., viii, 157.
P. phlyaria Mab., viii, 158.
P. fimbriosa v. Mart., iii, 158.
v. emoriens Gred., iii, 158.
v. nana Mlldff., iii, 158.
P. murata Hde., iii, 159.
P. stenochila Mlldff., iii, 159.

P. brachydiscus G.-Aust., iii, 162.
P. pseudophis W. Blanf., iii, 162.
P. nagæensis G.-Aust., iii, 161.

P. andersoni W. Blf., iii, 161.
P. plectostoma Bens., iii, 160.
prodigium Bens. *mss.*
P. macromphalus W. Blf., iii, 160.

P. munipurensis G.-A., iii, 160.
P. pinacis Bens., iii, 159.
P. pettos v. Mart., iii, 156.
P. oglei G.-Aust., iii, 159.
P. serica G.-Aust., iii, 159.
P. coarctata Mlldff. Nachrbl. '94, [104.

P. pulvinaris Gld., iii, 157.
P. jugatoria Anc., iii, 166.
P. reserata Hde., iii, 166.
P. multispira Mlldff., iii, 158.
P. cutisculpta Mlldff., iii, 158.
P. invia Hde., iii, 165.
P. secura Hde., Fl. Bleu, 141.
P. laminifera Mlldff., iii, 165.

Subgenus Traumatophora Ancey, 1887.

Traumatophora Anc., Conch. Exch., April, 1887, p. 54.

Shell disk-shaped, with low spire and open umbilicus; granulate. Whorls 5, regularly increasing, the last constricted behind the aperture. Aperture lunar, oblique, with reflexed lip, having within three entering lamellæ upon the outer lip, marked outside by grooves, no parietal processes. Type *P. triscalpta*, pl. 41, figs. 26, 27.

Anatomy unknown. This group and the next differ from *Plectopylis* in lacking transverse internal barriers, but until their soft parts are known they had better be grouped in this place.

P. triscalpta v. Mart., vi, 8. Central-southern China.
v. fraterminor Gredl. J. B. xi, 137.

Subgenus STEGODERA v. Martens, 1876.

Stegodera MTS., Novit. Conch., iv, p. 150.—PILSBRY, Man. vi, p. 7.—*Steganodera* KOBELT, Illust. Conchylienbuch, p. 236.

Shell *sinistral, disk-shaped,* with low spire and open, deep umbilicus; solid, opaque, brown. Inner whorls slowly increasing, regular; *latter half of the last whorl distorted, straightened,* covering the preceding whorl above. Aperture very oblique, crescentic, toothless; peristome reflexed; *throat very much contracted.* Type *P. angusticollis,* pl. 41, figs. 28, 29.

Anatomy unknown. A single species is known.

P. angusticollis v. Mart., vi, 7. Central China.

Genus CORILLA H. & A. Adams, 1858.

Corilla ADS., Gen. Rec. Moll., ii, p. 208.—SEMPER, Reisen (2), iii, p. 100 (Anatomy).—*Atopa* ALBERS, Die Hel., p. 90 (in part).

Shell planorboid, with nearly plane spire and broadly open umbilicus, the contour subcircular or oblong; rather solid, striated above, brown or yellow. Whorls 5–5½, the last deflexed in front. Aperture oblique, *the lip broadly reflexed or recurved,* its ends distant; parietal wall smooth or armed with a strong entering lamina. Interior of the last whorl either without laminæ, or obstructed by *a series of blades nearly parallel to the direction of the whorl, but having no transverse barriers.* Type *C. erronea* Alb., pl. 41, fig. 19. See also pl. 41, figs. 20, 21, 22, *C. rivolii* Desh. Pl. 41, figs. 23, 24, 25, *C. charpentieri* var. *hinidunensis*).

Foot (of *C. erronea*) with undivided sole and without pedal grooves. No mantle lappets. Kidney very short.

Jaw entirely smooth. Radula with about 79–85 teeth in a transverse row. Central tooth not smaller than the laterals, having a single cusp, shorter than the basal-plate. Laterals similar but asymmetrical. Marginals having a large, simple, oblique cusp longer than the square basal-plate (pl. 42, fig. 37, central, 1st and 24th teeth of *C. erronea*).

Genital system elongated, with no accessory organs on the female side. Spermatheca having a long duct, which branches into *a very long flagellum-like diverticulum,* containing a cylindrical spermatophore, which extended from the end of the diverticulum to the vagina. Penis short, swollen distally, continued in the vas deferens upon which the penis retractor is situated, *the distal end of the*

retractor being inserted on the uterus (pl. 42, fig. 38, *C. erronea*). This species is ovoviviparous, the uterus in the individual figured containing two young, having a membranous shell of about 5 mill. diam., and more than 3 whorls.

The shell differs from that of *Plectopylis* in lacking internal barriers transversely obstructing the passage. When internal lamellæ are present in *Corilla* they run parallel to the sutures or nearly so, as in *Polygyratia*. The central teeth are not smaller than the laterals as in *Plectopylis*, and there are further differences in the genitalia. All of the species are from Ceylon.

(*Group of C. erronea:* Parietal fold and internal plicæ present).

C. erronea Alb.. iii, 157.
C. rivolii Desh., iii, 156.
carabinata Fér.
C. anax Bens., iii, 157.
C. odontophora Bens., iii, 157.

(*Group of C. charpentieri:* no parietal fold or internal plicæ).

C. charpentieri Pfr., iii, 156.
v. hinidunensis Nev.
C. humberti Brot, iii, 156.

* * *

The nine genera following possess certain features in common, binding them into a great group which the writer, in 1890, named Macroön. The literature throwing light upon the anatomy and affinities of the members of this super-generic group is very restricted, three authors only having discussed them from the broad standpoint of modern Helicology. Semper, in 1873, recognized the alliance between *Acavus* and *Panda* (with which he also groups *Corilla* and *Caryodes*) shown in the short kidney, simple genitalia, smooth jaw and unicuspid teeth. Pilsbry, in 1890, announced that *Acavus*, *Panda*, *Helicophanta* and *Stylodonta* agreed in having eggs of extraordinary size, in which the young undergo prolonged antenatal development, and the shell actually attains a moiety of its whorls before the independent existence of the creature begins. Hedley, in 1892, studied the Australian forms, directing attention to features of their eggs, embryonic shells and anatomy not before appreciated, and gathering into one assemblage *Panda*, *Pedinogyra*, *Caryodes*, *Anoglypta* (and *Liparus*).

The group, as it is herein understood, contains snails with helicoid or bulimoid shells, viviparous or with large, hard-shelled eggs; the

jaw strong and ribless; *all of the teeth* of the radula unicuspid; the genital system without flagellum on penis and with no dart sac or mucous glands on vagina. To these characters we may add that the transverse rows on the radula are moderately straight (not V-shaped), the basal-plates of all the teeth are of the usual quadrate form, and the large embryonic shell is usually sculptured differently from the after-growth. The shell never has teeth or folds in the aperture, although the columella shows often a long spiral, producing a visible sinuosity or truncation below, which, incidentally, in some depressed forms, is shortened into a tooth-like columellar process.

The affinities of the genera *Plectopylis* and *Corilla* may be with this phylum, but if so, the connection is so remote or so much obscured by special modifications, that they may better be left isolated until more fully understood. The Adams brothers, Tryon, Fischer and others, guided by certain analogies in the shells, have classified these Indian genera with the American Polygyras and the Eur-Asian Gonostomas, but the group so constructed is shown by a study of the soft parts to be a house built upon the sand.

Genus STYLODONTA Crist. and Jan, 1832.

Stylodonta DE CRISTOF. et JAN., Catal. p. 2, type *H. unidentata.* —PILSBRY, Man. Conch., vi, p. 85.—*Stylodon* BECK, Index Moll., p. 46.—ALB.-MART., Die Hel., p. 149 (in part).—*Columplica* HARTM. (part) Gast. Schweiz, p. 187.—*Pachya* ALB., Die Hel., p. 107 (in part). For anatomy see W. G. BINNEY, Ann. N. Y. Acad. Sci., iii, p. 110 (teeth and jaw of *Studeriana*). VIGUIER, Arch. Zool. Expér. et Générale, viii, p. 529, pl. 40 (genitalia of *Studeriana*). SCHACKO, in Möbius' Beitr. zur Meeresfauna Maurit. u. Seychellen, p. 342 (anatomy of *unidentata*).—MARTENS in v. d. Decken's Reisen in Ost-Afrika, iii, i, p. 56, pl. 1 (varieties of *unidentata*).—NEVILL, P. Z. S., 1869, p. 61 (conditions of snail life on Seychelles).

Shell depressed-turbinate, solid, *with imperforate axis* at all stages of growth; obtuse apex; and *keeled periphery*, at least in the young. Surface yellowish or dark brown; whorls 5½, *the earlier* 3½ *spirally grooved or decussated, forming an embryonic shell about one-third the diameter of the adult*; outer whorls finely wrinkled, the last descending in front. Aperture wide-lunate, quite oblique, the peristome expanded or reflexed. *Columella short, subvertical, its inner edge with a convex lobe or a sharp tooth-like fold.* Type, *S. unidentata,* pl. 38, fig. 9.

Jaw stout, arched, *with no ribs*, but having a few coarse, broad vertical wrinkles (*Studeriana*), or weak, fine and close striæ (*unidentata*).

Radula large, composed of nearly straight transverse rows of teeth. *Central teeth with one broadly rounded cusp* shorter than the basal plates; laterals similar, but the cusp longer and inclined; marginals having an inclined broad mesocone and *developing a small ectocone* (pl. 48, fig. 9, *S. studeriana*).

In *studeriana* the radula measures 12½ x 5 mill., and the formula of teeth is 47.22.1.22.47. In *unidentata* the radula measures 10 x 4 mill., and the formula is 43.17.1.17.43.

Genitalia imperfectly known by Viguier's figures and description (see pl. 50, figs. 6, 7, 9, *S. studeriana*). The figures show the male system below, female system above. The penis is large. Vagina long, bearing a long duct ending in an oval spermatheca. Uterus large, containing two young shells, which are enclosed in membranous pouches, and attached to them by a sort of umbilical cord formed of the pouch wall (pl. 50, fig. 9). The uterus and pouches are filled with a glairy substance, probably nutritive, and secreted by the albumen gland. The organs above the uterus are unknown.

Large, solid Helices, inhabiting the Seychelles Islands. They are viviparous, bringing forth one or two young at a time. They live on bushes or climbing vines, feed upon green leaves, and æstivate under the soil or in rock crevices. Dufo supposed that only the lighter colored individuals were females, but his observations lack anatomical confirmation. The shells are very dull colored for arboreal forms.

Besides the viviparous reproduction, and the large size of the young at birth, these species are peculiar in having a small ectocone developed on the outer marginal teeth, the dentition being otherwise like that of *Acavus*. The large size of embryonal shell, the ribless jaw, and the peculiar teeth, all forbid the association of these shells with the genus *Camœna*. *S. studeriana* is found upon the island of Praslin only. It lives upon the leaves and trunk of the Coco-de-mer tree. *S. unidentata* occurs on Mahé, Félicité, Silhouette and Curieuse Islands. The young shells are acutely keeled, as in *Pyrochilus*, not rounded as in *Helicophanta*, *Acavus*, *Panda*, etc.

S. unidentata Chemn., vi, 86.
microdonta Dh.
uniplicata Hartm.
normalis Martens.

S. unidentata Chemn.
v. exanthematica v. Mts.
v. militaris Pfr.
v. globata v. Mts.

S. studeriana Fér. vi, 87.

Genus HELICOPHANTA Férussac, 1821.

Helicophanta Fer. (in part), Tab. Syst. des Anim. Moll., p. xxxii; Tab. Syst. de la Fam. des Limaçons, p. 23, 25 (contains, *premier groupe* Vitrinoides, *H. brevipes*, *H. rufa* and *deuxème groupe* Vesiculæ, *H. cafra*, *H. cornu-giganteum*, *H. magnifica*). —Beck, Index, p. 46 (except first species).—Albers, Die Hel., p. 110 (in part).—Alb.-Mart., Die Hel., p. 148, type *H. magnifica*.—*Leiostoma* Swains (in part) Malacol., p. 328.—*Eurycratera* H. & A. Ad., Gen. Rec. Moll., ii, p. 190.

Shell large, capacious, Helicoid or bulimiform, imperforate or umbilicate, consisting of 4–5 rapidly enlarging whorls, the several earlier forming the embryonic shell, *the diameter of which exceeds one-third that of the adult*; the *post-embryonic growth consisting of* 1½ *whorls or less, the last very large*, deflexed in front. Aperture large; lip narrowly expanded or reflexed, the columellar margin dilated at its insertion. Type *H. magnifica* Fér. (see pl. 38, fig. 4, *H. goudotiana*. Pl. 38, fig. 5, *H. cornugiganteum*).

Animal completely retractile into the shell, having the foot large and fleshy, sole not divided longitudinally, transversely wrinkled: sides of foot granular and obliquely deeply grooved down to the sole edge; tail rounded behind, smooth above. *Mantle margin enormously thickened*, having small right and left body-lobes (pl. 49, fig. 23, showing animal of *H. magnifica* completely retracted within the aperture, the end of tail visible in the mantle cavity).

Jaw strong, slightly arched, smooth; having no trace of vertical striæ (Pl. 49, fig. 19, *H. magnifica*).

Radula resembling that of Acavus, Ampelita, *and especially Panda*. Central and lateral teeth with single cusps, shorter than the basal-plates; marginals with long, oblique cusps (pl. 48, figs. 12, 13, *H. magnifica*, central with adjacent lateral, a lateral, and group of marginals, with outermost marginal tooth).

Genitalia opening near the right eye-tentacle. *Penis very large* and flattened, the retractor attached midway its length and inserted distally on the lung floor; vas deferens entering beyond the insertion of the retractor, and *continued inside in a vesicular enlargement of the penis-wall* to the apex of penis, where it opens into the large, *smooth-walled* penis-cavity. Vagina large, short; uterus large.

Spermatheca with a long duct, closely bound to the vagina (Pl 49, fig. 21, *H. magnifica* showing penis and lower portion of uterus and spermatheca duct. Fig. 20, reverse side of female side, showing vas deferens, etc. Fig. 22, penis split along line *a–b* in fig. 21, showing cavity. Fig. 23, section of enlarged wall of penis along line *c–d* of fig. 22, showing vesicular structure beyond the entrance of the vas deferens. Pl. 49, fig. 18, genitalia of *H. goudotiana*, after Brancsik.

The peculiar features of this genus are the very large size of the shell and its extremely large embryonal or nuclear portion; the great thickness of the fleshy mantle-edge, and the peculiar structure of the penis. The unicuspid teeth of the entire radula, and the smooth jaw, are characters common to *Acavus*, *Panda*, and other allied genera. The species are restricted to Madagascar, but the affinities of the genus are entirely with groups of the Seychelles Islands and Ceylon. It is not yet known whether the young are brought forth alive as in *Stylodonta*, or in eggs as in *Acavus*, *Panda* and *Borus*.

That Férussac intended his group *Helicophanta* especially for the glassy, vitrinoid shells subsequently called *Daudebardia*, is evident from his definition, grouping, and the etymology given; and some authors have used the name for these forms. But as Beck, Albers and v. Martens have chosen another course, it seems advisable to follow the precedent of such high authorities, especially since, by the "law of elimination," the same result is obtained. The only other course open to us would be to replace *Daudebardia* by *Helicophanta*, and use the term *Macroön* in a restricted generic sense for this Madagascar group.

The anatomy of *Helicophanta* is known by Semper's description of *H. magnifica* (Nachrbl., 1880, p. 60), and by a figure of the genitalia of *H. goudotiana* by Brancsik (Jahresheft des Naturwissenschaftlichen Vereines des Trencséner Comitates, 1892–3, p. 209, pl. 6, f. 5. The writer has examined *H. magnifica* in the flesh, and the figures on plates 48 and 49 are drawn from this specimen.

Group of cornugiganteum

H. cornugiganteum Chemn.vi, 60.
H. betsileoensis Ang., vi, 61.
H. ibaraoensis Ang., vi, 61.
H. guestieriana Cr., vi, 62.
H. vesicalis Lam. *bicingulata* Smith, vi, 63.

Group of magnifica.

H. magnifica Fér., vi, 65.
polyzonalis Beck.
H. souverbiana Fisch., vi, 66.
f. audeberti Mouss., vi, 67.

Group of goudotiana.

H. oviformis Grat., vi, 68.
v. phenax Pils., vi, 69.
H. goudotiana Fér., vi, 70.
H. echinophora Fér., vi, 71.
H. grandidieri C. & F., vi, 72.
H. partuliformis Bttg., vi, 72.
H. oomorpha Mab., vi, 49.

Group of farafanga, etc.

H. farafanga Ang., vi, 73.
farafanganensis C. & F.
H. gloriosa Pfr., vi, 68.
H. (?) follis Fér., vi, 74.

Genus ACAVUS Montfort, 1810.

Acavus Montf., Conch. Syst., ii, p. 234, type *H. hæmastoma.*—Semper, Reisen, p. 99 (anatomy).—Sarasin, Ergeb. Naturwissensch. Forsch. auf Ceylon, i, 1888 (embryology).—Binney, Ann. N. Y. Acad. Sci., iii, p. 92 (dentition).—*Otala* (in part) Schumacher. —*Oligospira* Ancey, Conch. Exch., ii, p. 22, 1887, types *H. waltoni* and *H. skinneri.*

Shell imperforate, globose-depressed or globose-trochoidal, solid, *bright colored.* Whorls less than 5, rapidly increasing, *the several earlier forming the nuclear or embryonic shell, which is about one-third the diameter of the adult.* Last whorl deflexed in front. Aperture very oblique, the *lip vividly colored and broadly expanded;* columellar margin long, obliquely descending, *broadly flattened,* the columellar lip adnate. Type *A. hæmastoma*, pl. 38, fig. 1.

Animal with undivided sole, and no pedal grooves; *lung and kidney very short,* the latter opening at the base of the kidney. Body-lobes of the mantle present, of moderate or small size.

Jaw strong, low-arcuate, entirely smooth, without median projection.

Radula having the teeth all unicuspid (pl. 50, fig. 8, 26, *A. skinneri.* Pl. 50, fig. 5, *A. phoenix.* Pl. 48, fig. 14, *A. hæmastoma.*

Genital system having no accessory organs. Penis having terminal retractor, the interior with two longitudinal pilasters below, with a very short, imperforate papilla at their base, at the base of which the vas deferens enters. Spermatheca on a *very short duct* (Pl. 50,

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fig. 1, *A. skinneri*. Fig. 3, *A. hæmastoma*). Eggs very large, oval, hard shelled (pl. 50, fig. 4, *A. phœnix*, natural size).

The section *Acavus* comprises Ceylonese Helices of large size and superb coloring. The shell is capacious, with a broad, polished lip of vivid red, lilac, or intense black hue. The young shells at the time of their extrusion from the egg are bright colored, with round periphery, and are about one-third the size of the adult. The teeth are all unicuspid, but the marginals have shorter cusps than in *Helicophanta* or *Panda*; and the shell differs from these groups in its broad columellar lip and brilliant coloring. They are arboreal in habit.

Group of A. hæmastomus.

A. hæmastomus L., vi, 78.
v. melanotragus Born., vi, 79.
v. conus Pils., vi, 79.
v. concolor, Pils., vi, 303.
A. fastosus Alb., vi, 79.
A. prosperus Alb., vi, 80.
A. phœnix Pfr., vi, 80.
A. superbus Pfr., vi, 81.
v. roseolabiata Nev., vi, 82.
v. grevillei Pfr., vi, 82.

Group of A. valtoni (Oligospira).

A. valtoni Rve., vi, 83.
waltoni auct.
A skinneri Reeve, vi, 84.

Genus PYROCHILUS Pilsbry, 1892.

Phania Alb., Die Hel., edit. Martens, p. 157, type *H. lampas*.—Martens Landschn. der Ostasiat. Exped., p. 325.—Pilsbry, Man. Conch., vi, p. 193.—Not *Phania* Meigen, Syst. Beschreib. Eur. zweiflügel. Insekten, iv. p. 218, 1824.—*Pyrochilus* Pilsbry, Proc. Acad. Nat. Sci., Phila., 1892, p. 391.

Shell large, solid, imperforate, depressed; *keeled at the periphery, at least in the young*; convex above and below, unicolored. *Junction of nuclear shell with the after-growth not distinct. Lip expanded, bright colored; columella widened into a flat plate*, adnate over the umbilicus, its inner edge blade-like. Whorls about 4½. Type *P. pyrostoma* (see pl. 38, figs. 2, 3, *P. lampas*).

Jaw of *H. pyrostoma* smooth, weakly arched, without median projection. Animal without caudal gland or mantle lobes. Internal anatomy unknown.

A group of handsome, large helices, all of which are still rare in collections. The brilliant coloring of the peristome and the widened

columella, as well as the smooth jaw, are characters which *Pyrochilus* shares with *Acavus;* but in the present group the embryonic shell is not differentiated or demarked from the post-natal portion, as is the oblong, globose nuclear shell of *Acavus;* and the young are acutely keeled, as in *Camœna.*

The few species are from Halmahera and Batjan, Moluccas.

P. lampas Müll., vi, 194.
carina Wood.
magna Schum.
gigas Swains.
P. sulcocinctus Mart., vi, 196.
P. pyrostoma Fér., vi, 194.
v. bucculenta Tap.-Can., vi, 195
v. extincta Tap.-Can., vi, 195.
P. xanthostoma Herk., vi, 197.

Genus AMPELITA Beck, 1837.

Ampelita Beck, Index Moll. p. 30 (proposed for *zodiaca, xystera, labrella, lancula, madagascariensis, clotho, alecto*).—Albers, Die Hel., 2d edit., p. 163.—Pilsbry, Man. Conch., vi, p. 16.

Shell *depressed,* solid and opaque, varying from broadly openly umbilicated to perforate; spire low, convex; the periphery rounded or keeled. Surface smoothish, sometimes malleated. Aperture very oblique, oblong-truncate; lip expanded above, reflexed below, toothless. Type *A. xystera* Val. (see pl. 41, figs. 31, 32, 33, *A. hemioxia*).

Foot indistinctly tripartite beneath, *the upper surface evenly tuberculate, without longitudinal grooves on back or tail.* Mantle-edge unusually thick, the right body-lappet very small, left lappet situated far to the left, and very low.

Jaw (pl. 51, fig. 5, *A. xystera*) rather widely arcuate, smooth, its anterior surface totally lacking ribs or striæ, very minutely denticulate in the middle of the cutting edge. The jaw figured measures 1.5 mill. wide.

Radula (pl. 51, fig. 4, *A. xystera.* Pl. 49, fig. 25, *A. sepulchralis*) composed of very broadly V-shaped, transverse rows; *all of the teeth unicuspid.* Cusps of all teeth wide and rounded, the centrals and laterals having the basal plates longer than the cusps, marginals with shorter basal plates, as usual.

Genitalia without accessory organs. Penis stout and short, the retractor and vas deferens inserted at its apex; walls of penis cavity corrugated, the vas deferens entering through a small papilla (pl. 51, fig. 6). Externally, *the lower course of the vas deferens is closely*

bound to the penis from its base to its apex; its free portion short. Duct of spermatheca long. Albumen gland large, *the ovisperm duct imbedded in it* nearly its whole length (pl. 51, figs. 1–3, 6, *A. xystera*. See also pl. 42, fig. 40, *A. loucoubeensis*).

Embryonal whorls about 2, indistinctly marked off from the after-growth; eggs unknown, but apparently one-fifth to one-seventh the diameter of the adult shell.

Distribution, Madagascar. The general aspect of the shells is that of ground snails, but the dentition is more like that of arboreal forms. The prominent features of this genus, apart from its discoidal and peculiar shell, are (1) that all of the teeth of the radula have single, simple rounded cusps, even the outermost marginals; (2) the ribless jaw; (3) the vas deferens is bound to the penis from apex to base of the latter, and the lower course of the ovi-sperm duct is bound to the albumen gland nearly the entire length of that gland.

The genitalia of *A. loucoubeensis* have been figured rudely by Brancsik (Jahresheft der naturwissenschaftlichen Vereines des Trencséner Comitates, xiv–xv Jahrgang, p. 209, pl. 6, f. 3, 1893). The anatomy of *A. xystera* and dentition of *A. sepulchralis* has been examined by myself. The species are numerous, and some of them at least are excessively variable, giving rise to an extensive synonymy. Most of those described without figures by Mabille may prove synonyms or varietal forms of the well-known species.

Group of A. sepulchralis.

A. sepulchralis Fér., vi, 18, 301.
labrella Lam.
f. sganziniana C. & F., vi, 301.
f. præclara C. & F., vi, 300.
f. olivacea Pils., vi, 300.
f. lethifera C. & F., vi, 300.
f. funebris v. Mart., vi, 19.
v. funebris Morel., vi, 301.
v. eurychila C. & F., vi, 301.
cadaverosus Pils., vi, 19.
f. pallidior C. & F., vi, 301.
f. excoriata Mart., vi, 22.
A. watersi Angas, vi, 26.
A. subsepulchralis Crse., vi, 22.
f. obscura C. & F., vi, 302.
f. minor C. & F., vi, 302.
sepulchralis Rv., f. 147 *b*.
f. nigropurpurea C. & F., vi, 302
A. hova Angas, vi, 24.
madera Mab., vi, 50.
polydora Mab., vi, 50.
A. stragulum C. & F., vi, 23, 302.
A. lamarei Mke., vi, 25.
v. sakalava Ang., vi, 26.
v. catarella Mab., vi, 49.

Group of A. omphalodes.

A. omphalodes Pfr., vi, 26.
v. loucoubeensis Cr., vi, 27.
lucubeensis Auct.
A. calypso Pfr., vi, 28.
v. intensior Pils., vi, 28.
A. chlorozona Grat., vi, 31.
A. vesconis Morel., vi, 31.
(?=*chlorozona.*)
A. basizona Mouss., vi, 29.
A. guillaini Pet., vi, 30.
A. consanguinea Fér., vi, 30.
v. subconsanguinea Pils., vi, 30
A. atropos Fér., vi, 20.
A. madagascariensis Lm., vi, 32.
madecassina Fér.
A. robillardi Ang., vi, 32.

Group of A. xystera.

A. novacula Mart., vi, 33.
A. hemioxia Pils., Naut., viii.
A. xystera Val., vi, 33.
A. shavi Smith, vi, 34.
A. stumpffii Kob., vi, 35.
f. albina Brancsik.
A. cazenavetti F. & B., vi, 35, 302
A. lancula Fér., vi, 36.
v. terveriana Grat., vi, 37.
A. fulgurata Sowb., vi, 36.
A. (?) testudo Pfr., vii, 89.
A. unicolor Pfr., vi, 37.

Group of A. lanx.

A. lanx Fér., vi, 38.
v. radama Less., vi, 38.
A. suarezensis C. & F., vi, 302.
A. lanciformis Bttg., vi, 39.
v. nossibeensis Bttg., vi, 40.
v. campbelliana Pils., vi, 39.

Group of A. duvallii.

A. duvallii Pet., vi, 41.
A. percyana Smith, vi, 42.
A. lachesis Fér., vi, 41.
A. clotho Fér. vi, 42.
A. granulosa Fér. vi, 43.
A. galactostoma Pfr., vi, 44.

Group of A. covani.

A. covani E. A. Smith, vi, 44.

Unfigured species of uncertain affinities.

A. campelica Mab., vi, 54.
A. cyanostoma Mab., vi, 48.
A. erythromorpha Mab., vi, 51.
A. galactostomella Mab., vi, 53.
A. gaudens Mab., vi, 54.
A. gaudiella Mab., vi, 55.
A. monacha Mab., vi, 47.
A. omoia Mab., vi, 46.
A. paropta Mab., vi, 55.
A. porcaria Mab., vi, 45.
A. scotina Mab., vi, 46.
A. stilpna Mab., vi, 53.

A. gonostyla Anc., vi, 45.
A. lithida Mab., vi, 53.
A. lychna Mab., vi, 52.
A. subfunebris Mab., vi, 55.
A. thelica Mab., vi, 47.

Subgenus Pœcilostylus Pilsbry, 1890.

Pœcilostylus Pils., Man. Conch., vi, p. 56.—*Eurystyla* Ancey, not Stal.

Shell compact and globose or globosely-elevated, imperforate or nearly so, smooth and shining, vividly colored. Peristome blunt, narrowly expanded, the columellar margin reflexed. Type *A. viridis* Dh., pl. 38, figs. 10, 11.

Anatomy unknown. These handsome shells have the appearance of the Philippine Island Cochlostylas. They are probably arboreal forms.

A. viridis Desh., vi, 56.
A. cerina Morel., vi, 57.

Genus PEDINOGYRA Albers, 1860.

Pedinogyra Alb., Die Hel., p. 162, type *H. cunninghami.*—Pilsbry, Man. Conch. vi, p. 13.—Hedley, Records of the Australian Mus., ii, 29, and Proc. Roy. Soc. Queensl. vi, p. 63, pl. 3, (anatomy).

Shell large and *discoidal, with flattened spire and broadly open umbilicus*, solid, opaque and colored. Whorls 5–6, the last large, *deeply deflexed in front.* Aperture oblong-truncate, nearly horizontal, the lip slightly expanded, blunt. Type *P. cunninghami*, pl. 17, figs. 5, 6.

Jaw arcuate, *ribless*, faintly striated transversely and longitudinally, the ends rounded (pl. 17, fig. 2, *P. cunninghami*).

Radula having *the middle cusp only developed, on all the teeth.* Centrals and laterals with the cusp shorter than the basal-plate. Marginals with a single ovate inclined cusp, projecting beyond the square basal plate (pl. 17, fig. 4, a central with 1st, 12th and 17th laterals, and 27th marginal tooth of *P. cunninghami*).

Genitalia having the penis long, retractor and vas deferens inserted at its apex, lower course of the latter large. Upper part of the vagina bearing the long stalked spermatheca, and *a long appendicula*, and bound firmly to the body-wall at this point. Ovo-testis imbedded in the digestive gland, as usual (pl. 17, fig. 1, *P. cunninghami*). Eggs globose, white, 9 mill. in diameter, hard, calcareous,

brittle, coarsely granular outside, smooth within (pl. 17, fig. 3, *P. cunninghami*).

Distribution, Queensland and New South Wales, Australia. *P. cunninghami* has been found living "under heaps of stones and drifts of dead leaves, or buried in clusters of from 3 to 6 in the soil. The sharp edges of broken shells are used by the aborigines of Port Curtis to polish their spears, boomerangs and waddies."

The more conspicuous characters of this type are its broadly umbilicated, quoit-like shell, the presence of an appendicula on the vagina, and the unicuspid marginal teeth. Both shell and dentition resemble the South American genus *Macrocyclis*. Two specific forms have generally been recognized: a large solid Queensland form, *cunninghami*, and a smaller, thinner, keeled form of New South Wales, *mühlfeldtiana;* but Hedley finds that they intergrade. This difference from north to south is exactly paralleled in other Australian Helices. Compare *Thersites richmondiana* of Queensland with *T. novæhollandiæ* of New South Wales; the solid, highly colored Sphærospiras, with the thinner, keeled Badistes, etc. It is a well established rule that as we pass southward from subtropical Queensland to the temperate southern regions of Australia, the shells become thinner, smaller, less richly dyed, and often develop a more or less obvious peripheral keel.

While the systematic position of this genus in the series cannot be regarded as unquestionable, I agree with Hedley that it is probably to be regarded as a depressed manifestation of *Panda*. It does not agree with that genus in that Pedinogyra has the ovo testis imbedded in the digestive gland. In *Panda* it is not so imbedded, but is free as in the Bulimi.

P. cunninghami Gray, vi, 14.
v. mühlfeldtiana Pfr., vi, 15.
v. compressa Mouss.
v. minor Mouss.

Genus ANOGLYPTA Martens, 1860.

Anoglypta v. Mart., Die Hel., p. 312, type *H. launcestonensis*.—Pilsbry, Man. Conch., vi, p. 92.—Hedley, Proc. Linn. Soc. N. S. Wales (2), vi, p. 22 (anatomy); and Rec. Austr. Mus., ii, p. 29.

Shell umbilicated, subtrochiform, conoidal above, convex below the peripheral carina; *lusterless and spirally lirate-tuberculate above, polished below.* Whorls 5½. *the apical ones spirally lirulate,* the last suddenly and deeply deflexed in front. Aperture small, subhor-

izontal; *outer lip thin, not expanded, having a projecting angle just above the periphery;* columellar lip slightly thickened and expanded toward the insertion. Type *A. launcestonensis,* pl. 29, fig. 16.

Animal having the sole undivided; upper surface granulated, the granules arranged in indistinct rows on the back; facial or lateral grooves distinct; tail pointed and flattened. Mantel edge thick, developing a large left body-lobe in front of the respiratory pore, and a triangular right one below and behind it. Genital foramen upon the right lateral groove, below and behind the eye stalk.

Jaw arcuate, with a slight median projection; very *finely, irregularly striated vertically* (pl. 47, fig. 6).

Radula having *all of the teeth unicuspid.* Central and lateral teeth (pl. 48, fig. 10) having the basal-plates contracted on the outer margin, forming a sort of socket for a projection on the inner margin of each succeeding plate. Marginals with long, broad, oblique cusps, becoming shorter on the outer ones (pl. 48, fig. 11, three groups of marginal teeth, the right hand group from the outer edge of radula).

Genitalia having a very short vestibule; lower part of vagina swollen, enlarging again above as it passes into the spermatheca duct. This duct is *very long,* slender and closely bound to the uterus above, ending in a globular receptacle. Below, the *lower portion of the duct is very large,* with muscular walls, *and bears a short blind sack, directed downwards.* This sack, and the enlarged duct and vagina together, have strongly ridged internal walls. Uterus having a very narrow neck (pl. 47, fig. 5, showing neck of uterus and its union with vas deferens, below the blind sack of spermatheca duct). Ovo-testis composed of a very long, straggling series of irregular clusters of fine follicles, imbedded in the liver along its inner surface. The penis has the vas deferens inserted below the apex, above and opposite to the insertion of the retractor muscle, which is very long, and attached distally *far back on the lung floor. Penis cavity closely and strongly ribbed* longitudinally, *with no papilla. Vas deferens firmly bound to the penis its entire length,* and also firmly bound to the vagina Pl. 47, fig. 8, showing course of *v. d.* on penis. (See pl. 47, figs. 5, 7, 8, *A. launcestonensis*).

Anoglypta is a monotypic genus created for one of the most peculiar of all Helices. In its coarse spirally lirate-tuberculate sculpture *A. launcestonensis* stands unique; and our knowledge of

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the soft parts of the animal throws but a feeble light on the questions of its origin and affinities. The eggs are like those of *Caryodes*. *The sculpture of the earlier whorls is almost exactly as in that genus.* The perfectly simple, unexpanded edge of the lip, and the basal color zone are also other points of likeness between *Anoglypta* and the *Caryodes, Panda, Pedinogyra* series. The genital system is peculiar in having the vas deferens closely bound in the integument of the penis, as in *Ampelita*, and in the backward-projecting sack on the spermatheca duct. This may perhaps be interpreted as an appendicula, or it may be an independent development for the reception of spermatophores, like the diverticulum in the true Helices. The jaw is not smooth, as in all other genera of the Macroön group, but finely striated as in *Pyramidula*. The radula is altogether similar to that of *Helicophanta, Panda, Caryodes*, etc. On the whole, it seems that Charles Hedley's estimate of the affinities of *Anoglypta* is by far the most probable yet advanced. The position assigned by von Martens, and those formerly suggested by the writer, are clearly untenable.

The only species of this genus, Mr. Hedley writes, is confined to a mountainous district in north-eastern Tasmania. He found it plentiful among the fern-tree gullies. "Habits very shy and timid, crawling very slowly. It frequents damp places under logs and decaying stems of tree-ferns. The fire and ax of civilization threaten to diminish the already narrow range of this splendid and interesting species, but its haunts are so rugged and remote that I do not fear its extinction."

A. launcestonensis Reeve, vi, 93. N.-E. Tasmania.

Genus CARYODES Albers, 1850.

Caryodes Alb., Die Hel., p. 141, type *Bulimus dufresnii*.—Martens in Die Hel., p. 228.—Semper, Reisen im Arch. Phil., Land Moll., p. 102 (anatomy).—Tenison-Woods, Proc. Linn. Soc. N. S. W. iii p. 81 (variation, etc.).—Hedley, Proc. Linn. Soc. N. S. W. (2), vi, p. 19 and Rec. Austr. Mus., ii. p. 29 (external anatomy, systematic position, etc.).

Shell *Bulimoid*, imperforate, varying from oblong to globose-ovate; thin but solid, composed of about 5 whorls, *the earlier ones spirally lirulate, separated by a crenulated suture*, apex obtuse, last whorl punctulate above, *encircled just below the periphery by a dark girdle* bordered with light. *Aperture higher than wide*, subvertical,

the outer lip thin and not expanded, *columella somewhat sinuous, subtruncate below*, with a closely adherent reflexed umbilico-parietal callus. Type *C. dufresnii*, pl. 46, figs. 15, 16.

Foot undivided and without pedal grooves. Back ornamented with long, narrow tubercles, arranged in about a dozen longitudinal rows; sides and tail divided into irregular polygonal spaces, which are partially subdivided and finely granulated; tail tapers slightly, is rounded behind, and never keeled. Genital orifice behind the right eye-stalk, just beneath the facial groove. Mantel with a left body-lobe. Kidney opening at its base.

Jaw arcuate, smooth, with no median projection (pl. 42, fig. 44).

Radula with 81–87 teeth in a transverse row, all of them unicuspid (pl. 49, fig. 24).

Genitalia (pl. 42, figs. 41, 42, 43) partially everted in the example figured, a short papilla bearing a long thread projecting from the foramen. Penis sac long and stout, the retractor and vas deferens inserted at its apex; within the penis lies an adnate fleshy pillar (pilaster), free at its distal end; its outer walls closely grooved, covered with thick epithelium, and in the folds lay irregular plates of lime. In a section the pilaster shows outside the external papilla, separated by grooves; then follows a sphincter muscle, then an irregular, apparently spiral muscle (pl. 42, fig. 43, pilaster, papilla and thread, Fig. 41. section of same, showing star-shaped cavity, etc.). Spermatheca having a long duct, near the mouth of which is attached a long appendicula.

Eggs hard-shelled, regularly oval, white, shining, minutely granular, measuring 11 by 8 mill. (pl. 42, fig. 46).

The external appearance of the animal and the form of the jaw, teeth and genitalia, are very similar to *Panda*, fully supporting the classification proposed by Hedley in 1892. The shell resembles that of *Panda* in its bulimoid contour, simple lip, and the sinuous subtruncate columella. It differs from that Australian genus in the lobed or crenulated sutures, and the sculpture of the embryonic whorls, which recall *Anoglypta*. The embryonic shell of *Liparus* differs very much in sculpture from that of *Panda*, *Caryodes* or any other Helix known to me.

The genus contains but one species, the *Bulimus dufresnii* of authors, *Helix dufresnii* Leach. The shell varies from oval to almost globose. The ground-color varies from light yellow to deep maroon or dull olive, but the color-band is permanent. The eggs

are disproportionately large for the animal, and deposited under logs during October and November. The size of the egg probably varies with that of the mature shell, as is the case with *Glandina*. The young, upon emerging, are obliquely orbicular in shape (pl. 42, fig. 45).

C. Dufresnii Leach. Tasmania.

Genus PANDA Albers, 1860.

Panda Albers, Die Heliceen, edit. Martens, p. 149, type *H. falconeri* Reeve.—Semper, Reisen, p. 103 (anatomy).—Hedley, Rec. Australian Museum, ii, p. 26 (anatomy and systematic position).—Pilsbry, Nautilus, vi, p. 9, May, 1892 (systematic position).—Not *Panda* Heyden, Isis, 1826, p. 612 (*Acarina*).

Shell Bulimoid rather than Helicoid, globose-oblong, higher than wide, umbilicate or imperforate, *thin* but strong. Surface smoothish. Whorls 4½, *the earlier two finely beaded*, indistinctly marked off from the smoother or spirally striated after-growth (pl. 46, fig. 12, *P. atomata*); apex obtuse. Last whorl very large, hardly descending in front. Aperture large, *subvertical, higher than wide*; *outer lip thin, not expanded*; columellar lip reflexed toward its insertion. Type *P. falconeri*, pl. 46, fig. 11 (*P. larryi*, pl. 46, figs. 13, 14).

Animal externally like *Caryodes*. Sole indistinctly tripartite; back with some ill-defined longitudinal granulation; sides and tail with flat, irregularly polygonal granulation; tail rather flat and sharply pointed. Lung cavity and kidney short. Mantle edge thick, without lobes (pl. 46, fig. 13, *P. larryi*).

Jaw arcuate, smooth, with a slight median projection or none (pl. 47, fig. 2, *P. atomata*.

Radula having all of the teeth unicuspid. Marginal teeth with long, oblique cusps (pl. 48, figs. 15, 16, *P. atomata*. Pl. 48, fig. 17, *P. falconeri*).

Genital system having the penis stout, the retractor attached to its summit, *and distally arising from the columellar retractor muscle*. At the base of the retractor is inserted an epiphallus about as long as the penis, then narrowing into the vas deferens. The epiphallus is partly filled by a "pilaster," or fleshy cord adnate along one side, which passes into the penis, and there expands into a peculiar penis papilla (fig. 3); internal walls of penis having having several weak longitudinal fleshy folds. High on the vagina opens the duct of the spermatheca, and opposite it enters *a long appendicula* (pl. 47, figs. 3, 4, *P. atomata*. Pl. 47, fig. 1, *P. falconeri*).

Eggs large, white, hard-shelled.

The special sculpture of the apex is generally worn off in adult shells. The latter whorls are peculiarly variegated with chocolate streaks and vermiculate lines on a yellow ground, and usually show spiral bands of blotches.

This genus is more nearly allied to *Caryodes* than to any other group. These two Australian genera resemble *Acavus*, *Helicophanta* and *Ampelita* in their smooth jaws, unicuspid side teeth and comparatively large eggs, but differ from them in the simple lip of the shell, the presence of an appendicula, the insertion of the penis retractor muscle on the main columellar retractor instead of on the floor of the lung, and in the freedom of the ovotestis from the digestive gland. The relationship between the Australian and the Indo-Madecassine genera is therefore by no means intimate. Hedley, in the important paper on these snails cited above, brought the Australian *Liparus* into the group he composes of *Panda*, *Caryodes*, *Pedinogyra* and *Anoglypta*, but I am unable to follow his classification to this extent. *Liparus* seems to me to belong to a distinct stock I look to *Otostomus*, *Placostylus*, etc., for its kindred.

The generic term *Panda* Heyden, 1826, has not been used by recent araneologists, and the definition given by Heyden in his analytical table is not sufficient to rescue it from the status of a *nomen nudum*. This antiquated use which can never be revived should not prevent us from retaining Albers' name for the present group.

P. falconeri Rve., vi, 75.
  v. maconelli Rve., vi, 76.
  v. azonata Hedl., viii, 293.
  v. tigris Hedl., viii, 293.

P. atomata Gray.
  v. kershawi Braz., viii, 293.
  v. elongata Hedl., viii, 294.
  v. azonata Hedl., viii, 294.

P. ponsonbyi Ang., P. Z. S. 1877, p. 170, pl. 26, f. 1.

P. larryi Braz., P. Z. S., 1871, p. 321.

* * *

The following genera, *Macrocyclis*, *Solaropsis* and *Chalepotaxis* are intercalated here in the Helix series provisionally, pending the discovery of their true affinities by the examination of the internal anatomy. The dentition of *Macrocyclis*, now for the first time made known, is excessively peculiar, and comparable only to that of *Helicophanta* and its allies. Of *Solaropsis* there is nothing known sufficient to justify a guess at its affinities. *Chalepotaxis* has the

highly modified radula of a tree-snail, but so abnormal that it affords little ground for conjecture.

The Indo-Chinese group *Ganesella* is placed here because it was omitted in its proper place in the Epiphallogonous series, with *Chloritis, Planispira, Papuina*, etc.

Genus MACROCYCLIS Beck, 1837.

Macrocyclis Beck, Index Molluscorum p. 24, for *H. peruviana* (*laxata*) and *H. cunninghami*.—Albers, Die Hel. p. 128 (restricted to *H. laxata*).—Martens, Die Hel. p. 75 (in part).—Not *Macrocyclis* of American authors,=*Selenites*.

Shell *disk or quoit shaped* with low, convex spire and *widely open* funnel-shaped *umbilicus*. Whorls 4½–5, the last large, *deeply descending in front;* finely and densely striated; yellowish, not banded. Aperture very oblique, oval, wider than high, the peristome narrowly expanded throughout, reflexed below, the ends approaching. Type *M. laxata* Fér., pl. 22, figs. 11, 12.

Genitalia, jaw, etc., unknown. Radula strap-shaped as usual, bearing many rows of 33.1.33 teeth, *all unicuspid;* centrals with the single conical cusp projecting beyond the basal-plate; laterals similar but asymmetrical; marginals like the laterals, but the basal-plates are shorter and the cusps longer, oblique and simple (pl. 51, figs. 1, 2, central with adjacent 3 laterals, 6th and 9th laterals, 12th and 13th transition teeth, 16–18 and 25–33 marginal teeth, of *M. laxata*).

The shell in this group, except in being uniformly light colored, is strikingly like that of the Australian *Pedinogyra*; and the dentition is altogether similar to *Pedinogyra, Panda, Anoglypta* and *Helicophanta* in the total absence of side cusps; the marginal teeth having long, oblique mesocones as in those Old World genera. In view of the fact that, although unicuspid marginal teeth are peculiarly characteristic of the *Macroon* group, they reappear in a few other Helices, I do not feel justified in associating *Macrocyclis* with *Pedinogyra* and its allies. We may better suspend judgment until the genitalia and jaw give their more definite testimony. The radula is very different from that of *Selenites*.

The single species inhabits Chili.

M. laxata Fér., iii, 109.
peruviana Lam.
deshayesii Anton.
cincinnus Rve.

Var. banksii Cuming, iii, 109.
maxima Beck.
umbilicata Anton.
? *gayi* Hupé.
laxata Rve.

Genus SOLAROPSIS Beck, 1837.

Solaropsis Beck, Index Moll. p. 27 (for *heliaca, moricandi, braziliensis, pellisserpentis*).—Martens, Die Hel., p. 164 (type *H. pellisserpentis* Ch.); Ostas. Landsch. p. 7 (jaw).—Pilsbry, Man. Conch. v, p. 177.—*Solarium* Spix, Test. Brazil, p 23.—*Helicella* Swains. Malacol., p. 333 (1840).—*Psadara* Miller, Malak. Bl. xxv, p. 162, 1878, (for *boetzkesi, selenostoma, iris*).—*Ophiospila* Ancey, Conchol. Exch., i, p. 64, 1887 (*kühni, andicola*, etc.)

Shell umbilicate, rather depressed, with convex or flat spire, convex below, the periphery rounded or angular. Decorated with *a peculiar pattern of lunate brown spots and streaks in bands on a light ground.* Surface granulate, hirsute or plicate-striate. *Last whorl not deflexed in front.* Aperture oblique, lunate; lip expanded or reflexed, its ends distant. Type *S. pellisserpentis.* (See pl. 46, fig. 20, *S. serpens;* fig. 21, *S. braziliana*).

Animal long and slender; jaw smooth, without ribs; anatomy otherwise unknown.

Distribution, southern Brazil and Peru to Columbia and Guyana; one species *S. tiloriensis*, in Costa Rica. They are forest snails, living under stones and bark, etc.

The name *Ophidermis* Agassiz (*Ophiodermis* Herrm.), said to have been proposed in Charpentier's Catalogue of Swiss Mollusks, 1837, but not mentioned therein, has found its way into the synonymy of this genus, through a guess of Herrmannsen's based on its suggestive etymology. It was never published except as a nude name, for the snake skin can hardly be said to cover its nakedness. It is not now worth the expense of clothing; especially since it really pertains to something of the nature of *Cyclostoma* (see Agassiz, Nomencl. Zool., Moll., p. 62).

S. pellisserpentis Chemn., v, 178.
constrictor Hupé.
S. serpens Martyn., v, 178.
pellisserpentis Hupé *et al.*
colubrina Perry.
S. pellisboæ Hupé, v, 180.
boa Hupé.
S. anguicula Hupé, v, 180.
S. vipera Pfr., v, 181.
S. monolacca Pfr., v, 182.
S. napensis Crosse, v, 188.
S. rosarium Pfr., v, 188.
S. kuhni Pfr., v, 189.
S. andicola Pfr., v, 189.
S. quadrivittata Hid., v, 190.
S. diplogonia Dohrn., v, 190.
S. nubeculata Desh., v, 191.
S. catenifera Pfr., v, 191.
S. catenulata Anc., viii, 261.
S. marmatensis Pfr., v, 191.

S. gibboni Pfr., v, 182.
magnifica Lea not Fér.
v. amori Hid., v, 183.
v. cousini Jouss., v, 183.
S. præstans Pfr., v, 184.
S. braziliana Fér., v, 184.
? *moricandi* Beck.
S. heliaca Orb., v, 185.
S. pascalia Caill., v, 186.
amazonica Hupé.
S. amazonica Pfr., v, 186.
S. feisthameli Hupé, v, 187.
punctata Wagn. not Müll.
v. planior Pils., v, 188.
S. incarum Phil., v, 192.
S. monile Brod., v, 192.
planorbis Jay.
boetzkesi Mill.
S. castelneaudii D. & H. v, 193.
castelnaudii Hupé.
castelnaui Pfr.
S. selenostoma Pfr., v, 193.
sclerostoma Rv.
S. hians Pfr., v, 194.
S. tiloriensis Ang., v, 194.
S. iris Mill., v, 195.
S. rugifera Dohrn., v, 195.
S. elaps Dohrn v, 196.

Genus CHALEPOTAXIS Ancey, 1889.

Chalepotaxis Ancey, Conch. Exch. Aug. 1887, p. 22, type *Nanina ? infantilis* Gredl.—*Cf.* SCHACKO, Jahrb. D. M. Ges. XI, p. 157, pl. 3, f. 7–10 (dentition).

Shell small, thin, shining, orbiculate-depressed, with narrow umbilicus and low-conic spire; last whorl scarcely descending in front; aperture lunate, slightly oblique, the peristome simple and unexpanded except at the columella, where it is slightly dilated. Type *C. infantilis* Gredler, pl. 57, fig. 34.

Jaw very delicate. Radula (pl. 57, figs. 35–39, *C. infantilis*) with the formula 25.1.25. Teeth all similar in form and in v-shaped rows. Middle teeth having the median cusp enormously dilated into an elliptical gouge projecting far beyond the basal-plate; neck of the cusp narrow, bottle-shaped; side cusps basal, rudimentary and vertical; basal-plate narrow in front, widening and squared behind. Lateral teeth similar, but the large cusp bends outward and the entocone is suppressed. Marginals differ only in becoming smaller, with the ectocone decidedly longer (pl. 57, figs. 35, 37, group of middle and lateral teeth; fig. 36 group of marginals; fig. 38, a lateral in profile, turned 90°; fig. 39, a lateral turned 45°).

This genus is founded upon one species having a shell resembling an immature *H. similaris* Fér., or *pyrrhozona* Phil. and a type of dentition considerably like *Oxychona*. The jaw is very imperfectly known, and the genital system is unobserved. I am disposed to

believe, with Schacko, that it is a modified branch of the Helix stock. It is probably arboreal in habit. Only species, *C. infantilis* Gredl., ii, 216. Prov. Kwang-si and Hunan, China; Tonquin.

Genus GANESELLA Blanford, 1863.

Ganesella Blanf. Ann. Mag. Nat. Hist. (3), xi, p. 86, type *H. capitium* Bens. (Feb., 1863).—*Satsuma* A. Adams, Ann. Mag. (4), i, p. 463, type *H. japonica, patruelis, peculiaris,* (June, 1868).—*Fruticotrochus* Kobelt, Fauna Molluscorum extramarinorum Japoniæ, 1879, p. 48, same types.—*Trochomorphoides* Nevill, Hand List Moll. Ind. Mus. pt. 1, p. 80, type *H. acris* Bens. (1878).

Shell more or less trochiform, umbilicated (or rarely imperforate), rather thin; light-colored, plain or with a peripheral line; surface with growth-lines only or densely spirally striate; whorls 4½–6, the last a little descending in front. Aperture oval or angular-lunate, oblique, toothless or with a blunt columellar fold; lip expanded, broadly dilated at columellar insertion. Type *G. capitium*, pl. 55, fig. 18. See also pl. 64, fig. 7, *G. japonica.*

Animal (of *G. japonica*) with *the foot very long and narrow,* sole not distinctly tripartite; upper surface finely and feebly granular, back with a pair of dorsal grooves, no facial grooves; tail narrow, long, *with a median longitudinal groove above.*

Jaw arcuate, with about 9 ribs denticulating the lower margin (pl. 60, fig. 1, *G. japonica*).

Radula of the type usual in ground snails. Middle tooth with mesocone only developed, shorter than basal-plate, side-cusps represented by slight lateral extensions. Laterals similar but with the cusp longer. Marginals with oblique, bifid inner cusp and an ectocone (pl. 60, fig. 2, *G. japonica*).

Genital system (Frontispiece, figs. 1, 2, *G. japonica*) having the penis long and twisted, ending in a curved blind sack with corrugated inner walls (fig. 2, apex of penis and sack opened); epiphallus long, bearing the retractor, terminating in a flagellum and the vas deferens. Vagina extremely long, the spermatheca duct inserted high. Spermatheca oblong, on a stout duct, neither duct nor bulb being bound to uterus. No dart sack or mucus glands.

Distribution, Japan and China to India, southeast to Sumatra Borneo and Philippine Is.

This genus has the genital system, jaw and radula, as well as the tail-groove of *Chloritis* (see Pl. 28, figs. 1 to 9), but the penis-papilla

is absent, and the spermatheca duct is inserted higher on vagina. The shell has somewhat the contour of *Papuina*. The anatomy of the group has been a complete surprise to me, for I had relegated it to the *Eulota* group before dissecting specimens. It is now perfectly clear that it belongs in the vicinity of *Chloritis* and *Papuina*, and is the most northern in distribution of that group of genera. Probably some of the species now referred to *Ganesella* will prove to belong to other groups, such as the East Asian Fruticicoloid section.

There is much variation in contour, number of whorls, size and umbilicus among the members of this genus; and a subdivision of it into sections will no doubt be made eventually. It is to be hoped that such division will not be attempted until it can be placed on a firm footing by the examination of the anatomy of many species; and anatomical data are also required before the boundary line between *Ganesella*, *Eulota*, *Plectotropis* and the East Asian Fruticicolas can be definitely drawn. In some cases the shell alone is not sufficiently characteristic to base the classification of these groups upon, even when the relationships of the main types have been elucidated.

Japanese, Liukiu Is. and Formosa species.

G. papilliformis Kob., iii, 217.
G. japonica Pfr., iii, 218.
? *vitracea* Fér., vii, 106.
G. conospira Pfr., iii, 218.
G. tabuensis Anc., iii, 218.
patruelis Ad. not Ang.
G. sphinctostoma Ad., iii, 218.
G. cardiostoma Kob., iii, 219.
G. hilgendorffi Kob., iii, 219.
G. verrucosa Reinh., iii, 219.
G. macrocycloides Kob., iii, 219.
G. eumenes West., viii, 199.
G. goodwini Sm., iii, 219.
G. conulina Mart., iii, 219.
G. conella Ad., iv, 56.
G. lischkeana Kob., iii, 220.
G. peculiaris A. Ad.
G. gibbosa A. Ad.
G. ? serotina A. Ad.
G. sphærulata Reinh.
G. largillierti Ph., iii, 218.
immaculata A. & R.
G. albida Ad., iii, 218.
G. fulvicans H. Ad., iii, 220.
G. sphæroconus Pfr., viii, 200.
v. campochilus Pils., viii, 201.
G. scævola Mts., vi, 306.

Chinese species.

G. gradata Mlldff.
G. brevibarbis Pfr., iii, 221.
G. alveolus Hde.
G. ternaria Hde.

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G. squamosella Hde., iii, 221.
G. micacea Hde., iii, 221.
G. phyllophaga Hde., iii, 221.
G. dormitans Hde., iii, 222.
G. ? arbusticola Dh., iii, 222.
G. bizona Gredl.
G. squamulina Gredl.
G. trochacea Gredl., viii, 200.
G. microtrochus Möll., viii, 201.
G. lepidostola Hde., iv, 55.
v. trochospira Mlldff.
G. schomburgiana Mlldff.
trochulus Mlldff. not Ad.
G. vitreola Hde.
G. ingloria Hde.
G. subsquamulata Hde.
G. subparasitica Hde.
G. subgriseola Hde.
G. ? galera Hde.
G. ? peræruginosa Hde.
G. radulina Hde.
G. virilis Gredl., iv, 259.
v. subfusca Gredl.
G. laurentii Gredl., iv, 259.
G. editha A. Ad., viii, 204.

Species of India, Tonquin, etc.

G. capitium Bens., iii, 74.
v. hariola Bens., iii, 74.
G. acris Bens., iii, 74.
puellula Bens.
G. perakensis Cr., vii, 82.
v. subperakensis Pils., vii, 82.
G. galea Bens., iii, 75.
G. phonica Mab., vii, 83.
G. bouryi Morg., iii, 172.
G. rostrella Pfr., vii, 83.
G. scenoma Bens., vii, 83.
G. hyperteleia Morl., viii, 203.
G. mera Rve., iii, 94.

Species of Sumatra, Java and Borneo.

G. gysseriana Pfr., iii, 75.
? *conulus* Mart. not Pse.
G. bantamensis Sm., vii, 84.
G. rufofilosa Bock, vii, 84.
G. niahensis G.–A., vii, 85.
G. tigæensis G.–A., vii, 85.
G. subflava G.–A., vii, 85.
G. angulata Iss, iii, 75.

Philippine Island species.

G. trochomorpha Mlldff., viii, 202.
microtrochus Mlldff. *olim.*
v. mimula Mlldff.
v. dimidiata Mlldff.
G. trochus Mlldff., viii, 201.
G. fernandezi Hid., viii, 202.
G. planasi Hid., viii, 202.
G. poecilotrochus Mlldff. Nachr. ['95, 114.

A section of *Ganesella* is probably indicated by the lack of flagellum and the columellar fold of *H. ptychostyla* (see Semper, Reisen, p. 247, footnote, pl. 16, f. 27). The appendage of penis, figured for *G. japonica*, is developed, and somewhat sacculated or feathered. These

species were formerly grouped in *Plectotropis*, but the lack of dart sack and mucus glands widely sunders them from that group.

G. ptychostyla Mart., iv, 58.
goniochila Pfr., iv, 58.
G. styloptycha Pfr., iv, 58.
ptychostyla Pfr. not Mart.
f. depressior Pfr.

Subgenus (?) BULIMINOPSIS Heude.

Buliminopsis HDE., Notes sur les Moll. Terrestr. de la Vallée du Fleuve Bleu, p. 146, type *H. buliminus.*—*Conf.* v. Molldff., Nachr. d. m. Ges. 1886, p. 195.—*Rudens* HDE., *t.* c., p. 148. type *Funiculus rudens.*—*Pseudobuliminus* Gredl., SCHMACKER & BOETTGER, Nachr. D. M. Ges. 1891, p, 164.

Shell elevated conic, perforated, the spire acute, 7–8 whorls; aperture small, oblique, peristome expanded. Soft parts unknown.

A middle Chinese group of uncertain position. Möllendorff refers it to *Satsuma*, Ancey to *Buliminus*, while Heude and Gredler cut the Gordian knot by removing the species from both genera.

G. pseudobuliminus Hde., iv, 31.
B. macrogonus Anc.
G. buliminoides Hde., iv, 31.
B. tropidophorus Anc.
G. buliminus Hde., iv, 32.
B. helicopsis Anc.
v. pinguis Anc.
G. macroceramiformis Dh.
G. incerta Pfr.
taivanica Mlldff., iv, 33.
G. quaternarius Hde.
borealis Hde. on pl.
G. conoidea Hde.
G. doliolum Gredl.
F. rudens Hde.

Subgenus (?) COLIOLUS Tapparone-Canefri, 1887.

Ann. Mus. Civ. Genov. (2), iv, p. 131.—Manual of Conchology (2) vii, p. 87. Not *Coleolus* Hall, Paleont. N. Y. v, p. 184, 1879.

Shell elevated-conic, many (eleven) whorled, upper whorls spirally striate, the rest obliquely costulate and setigerous; apex obtuse, mamillar; base depressed; peristome reflexed below, margins distant, connected by a callus. Type *C. arfakiensis* Tap.-Can. vol. vii, p. 87.

Soft parts unknown. Inhabits New Guinea. This peculiar snail is considered an ally of *Trochomorphoides* by Tapparone-Canefri. Perhaps it may prove to belong to the Charopoid series.

Genus DORCASIA Gray, 1845.

Dorcasia Gray, Zeitschr. f. Mal. 1845, p. 87, type *H. alexandri*; P. Z. S. 1847, p. 171.—Binney, Ann. N. Y. Acad. Sci. iii, p. 106, pl. 6, f. M (Dentition).—*Galaxias* (part) Beck, Index Moll., p. 42 (preoc.).—*Cf.* Pfeffer, Verh. Vereins f. naturwissench. Unterhaltung zu Hamburg, vi, p. 118, 1887. Also Simroth & Boettger, Berichte d. Senckenb. Gesellsch. 1885, p. 16, pl. 1, f. 2 (as "*Bulimimus* sp.").

Shell rather large and solid, glossy and unicolored; umbilicated, globose or depressed with rounded periphery, rather conoid low spire and deflexed last whorl. Aperture oblique or subhorizontal, rounded-truncate, toothless; the lip thickened, and reflexed at least below. Type *D. alexandri*. See pl. 38, figs. 6, 7, *D. alexandri var. rotundata*. Also *D. globulus*, pl. 38, fig. 8.

Jaw low, wide, slightly arcuate, *entirely smooth* (pl. 60, fig. 3, *D. alexandri*). Foot (of *alexandri*) short and broad, the sole very indistinctly tripartite; upper surface coarsely granular, the granules polygonal, subdivided; with no trace of pedal grooves; back with several longitudinal lines, obsolete toward head; facial grooves well marked and continuous from mantle to head, on both sides; tail more finely granose, obtuse behind, rounded above, without median groove. Mantle with small right and left body-lobes. Right eye-stalk retracted between branches of genitalia. Blind sack of the foot very long, lying free in body cavity.

Radula (pl. 60, fig. 6, *D. alexandri*) having mesocones only developed on middle and inner lateral teeth, the side cusps being represented by lateral extensions of the mesocones. On the outer laterals and marginals the ectocone becomes distinct and well developed. In *D. globulus* (pl. 51, fig. 3,) both median and lateral teeth are distinctly tricuspid. Marginals a simple modification of the laterals, the broad cutting-point trifid.

Genital system (frontispiece, fig. 3, *D. alexandri*) *without accessory organs of any kind.* Atrium very short. Penis long, larger, and abruptly bent toward the apex where the terminal, short retractor is inserted, its distal attachment being on the lung floor. *The vas deferens is not terminal,* but enters about one and one-half millim. below apex of penis. Vagina long; spermatheca on a long branchless duct, entering high on vagina.

The specimen of *D. alexandri* examined by me was kindly communciated by Dr. Simroth, and is the same one which supplied the data given in Ber. Senck. Ges. 1894. It is a badly preserved spirit example, and shows signs of immaturity.

The dentition of *D. globulus* differs from that of *alexandri* in the development of side cusps, which are represented in the latter by wide extensions of the mesocones. This is not an unusual variation. The smooth low jaw recalls *Helicophanta*, but the egg is apparently minute in *Dorcasia*, and we have from the mouth of the animal itself an emphatic contradiction of such a relationship, for the teeth are totally unlike the unicuspid type of the *Helicophanta* and *Ampelita* group.

The entire simplicity of the genital system shows *Dorcasia* to belong to the Euhaplogona, most living members of which are restricted to America, *Polygyra* being a leading genus. In this group of genera the penis bears neither epiphallus nor flagellum, the vagina or atrium have no dart sack or mucus glands, the duct of the spermatheca does not branch into a diverticulum. *Dorcasia* is, therefore, isolated among the Helices of Africa, Asia and Europe. It is interesting to note that many of its associates in the Cape fauna are equally so, and mainly belong to a much older fauna than that occupying these continents: *Aerope* has its allies only in Australia, Tasmania and New Zealand; *Trachycystis* (Pella) has the same geographic alliances; *Peripatus* has a similar, though wider, range; and many other Cape animals could be named which belong to an archaic fauna.

With Oriental snails of the type of *H. similaris* Fér. (*Eulotella*), these South Africans have no especial relations.

All of the species are from the South African zoological province, with the exception of the doubtful *D. votiva* Cr., from Madagascar, which differs from all the other species in being banded.

D. rosacea Müll., iii, 213.
D. porphyrostoma M. & P., viii, [262.
D. globulus Müll., iii, 213.
lucana Lam., Fér., Rossm.
D. namaquensis M. & P., viii, [262.
D. gypsina Melv. & Pons., viii, [262.
D. coagulum Mts., viii, 263.
D. lucana Müll., iii, 213.
D. inhluzana M. & P.
D. usambarica Crav., iii, 155.
D. kraussi Pfr., iv, 50.
D. cernua Mts., viii, 263,
D. alexandri Gray, iii, 213.
v. minor Bttg., viii, 261.
v. rotundata Mss., viii, 261.
D. ? bulbus Mke., iii, 213.
D. ? votiva Crosse, iii, 214.

* * *

Belogona.

The series of genera following are characterized by the possession of organs wanting in all other Helices, viz. a muscular sack (or sacks) on atrium or vagina containing a calcareous needle or dag-

ger like "dart," and a gland or glands inserted upon or above this sack, the so-called "digitate glands" or mucus gland.

The presence of these organs was early noticed by European malacologists, but their significance has been only recently recognized. Semper in 1874 made two divisions of rib-jawed Helices, those genera with no accessory organs on genitalia, and those with such accessories; and in 1888 the writer used these features of the genitalia as diagnostic of various groups of Helices, elaborating the idea in a later paper (1892). Meantime Dr. H. von Ihering issued a paper of great merit, "Morphologie und Systematik des Genitalapparates von Helix," in which he proposes to restrict the family *Helicidæ* to snails with *grooved or ribbed jaws and possessing the dart apparatus*, including therein as genera—*Xerophila*, *Fruticicola*, *Helix* (=Pentatænia), *Campylæa*, *Gonostoma*, *Dorcasia* (=Eulota), and *Cochlostyla*. In the following pages I have adopted all of these groups as genera (although altering the names of most of them), and with the exception of *Campylæa* and *Dorcasia*, they are retained with the limits defined by von Ihering. I need give no other expression of the high esteem in which I hold v. Ihering's work, than this use of it. It should be added, however, than many genera not noticed in von Ihering's paper, are now included in this group, some of which have ribbed, some smooth jaws. His family diagnosis of "Helicidæ", therefore, does not cover nearly all the forms here grouped under *Belogona*.

The relationship of the Belogona to the Epiphallogona is discussed in the introductory portion of this volume. It remains to study the internal affinities of its numerous genera. It has been seen that the Belogona differ from Epiphallogona only by the addition of the dart apparatus, the penis having exactly the same morphology in the two groups. Now the simplest type of dart apparatus is that found in the genus *Helicostyla*, consisting of a sack containing a needle-like dart, without crown or blades, and a simple, mucus gland *upon the dart sack*, consisting of one layer of secreting cells arranged radially around a central space or duct (see pl. 54, fig. 7). This is, there can be no doubt, the primitive type of the dart apparatus, from which the various elaborate forms of darts and glands arose. No really primitive Belogona are now known to exist. *Helicostyla* is practically so in its dart arrangement, but it is divergent in the loss of the flagellum (present in its Epiphallogonous ancestors) and in the highly modified shell.

The anatomy of the European types of dart-bearing helices has been studied by Schmidt, Lehmann, Moquin-Tandon, and many

later authors. The American forms have been studied by W. G. Binney, but as many of his figures are of doubtful accuracy my conclusions have been based wholly upon fresh dissections. The West Indian genera are herein for the first time made known anatomically; and the forms of East Asia are partially known by the work of Semper, but largely by my own dissections. The great mass of data before me from these sources, has compelled me to reject von Ihering's phylogenetic scheme, and to offer the following arrangement:

BELOGONA EUADENIA. *Mucus gland one, inserted on dart sack or at its base; simple or divided, glandular, sacculated, globular or bulbous.*

BELOGONA SIPHONADENIA. *Mucus glands usually two or many, inserted on vagina; tubular or composed of tubular branches.*

Apparent exceptions to this arrangement are seen in Helicigona quimperiana, where the tubes are shortened into hollow, thin-walled sacks, and some Fruticicoloid forms with demonstrably degenerate genitalia. The first of these divisions will now be discussed:

BELOGONA EUADENIA.

This division of the Belogona, characterized by having mucus glands of typically glandular structure, in contradistinction to the tube-like glands of the *Siphonadenia*, is now distributed throughout Eastern Asia, outlying groups extending to New Guinea and the Solomon Is., and northward to Japan and Siberia. In America it occupies the Pacific slope from British Columbia to Argentina, with genera in the Greater Antilles. It is a significant fact that its area while in large part coincident with that of the Epiphallogona (*Hadra, Camœna, Obba*, etc.) is over stepped on nearly all sides by the latter. Thus *Planispira* extends further west in India; *Thersites* (+Hadra) and *Chloritis* extend beyond it southward to Australia; *Papuina* has a far greater range throughout the "Melanesian Plateau"; and *Ganesella* follows the Euadenia to the confines imposed by rigorous climate in the north. And in the New World, again, while both *Euadenia* and *Epiphallogona* have a wide range in South America, the latter are universally dispersed throughout the Caribbees as well as the Greater Antilles, whilst the former came too late to follow them to the Caribean chain. The inference is, of course, that the *Epiphallogona* are an older faunal element, and have had more time to take advantage of the various means of dispersal by which islands (especially continental islands) and continents have been peopled.

A single European genus, *Leucochroa*, is herein referred to the Euadenia; but it is a degenerate group in genitalia and jaw and may prove to belong to the *Siphonadenia*, in the vicinity of *Helicella* (Xerophila), which it resembles in the simple-lipped, chalky shell and the peculiar musculature. The American genus *Lysinoe* is also aberrant, differing from all other *Euadenia* in having three club-shaped mucus glands inserted on vagina, and in the doubling of the dart sack; but it differs from all *Siphonadenia* as well in having the mucus glands inserted one behind the others, instead of at the same level on the vagina. I have considered it a tangent from the *Epiphragmophora* circle. *Oxychona* is still imperfectly known.

The genera of this division may be tabulated as follows:

a. New World genera.

1. Dart sack 1, with subapical constriction, apex attached by a thread to vagina; mucus gland 2-lobed; jaw smooth; tail not serrate.
   b. Middle and inner lateral teeth 1-cuspid, marginals 3-cuspid, [CEPOLIS.
   bb. All teeth with three *subequal* cusps, POLYMITA.
2. Dart sacks 2; mucus glands 3, on vagina; tail with serrate keel; jaw ribbed.
   b. Teeth of normal type; shell subglobose, large, deep colored, [LYSINOE.
   bb. Teeth with wide middle and minute side cusps; shell trochoidal, OXYCHONA.
3. Dart sack 1; mucus glands absent, jaw ribbed; shell discoidal with thin, simple and acute lip, GLYPTOSTOMA.
4. Dart sack 1; mucus gland single, club-shaped, bifid and bulbiferous, or 2 with flat glandular extremities adnate on vagina or d. s., EPIPHRAGMOPHORA.

aa. Old World genera.

1. Dart sack 1, well-developed.
   b. Mucus gland single, globose, inserted on dart sack, [HELICOSTYLA.
   bb. Mucus gland acinose; shell bright colored, CHLORÆA.
   bbb. Mucus gland divided, lobes sacculated, elongated, EULOTA.
2. Dart sack wanting; jaw smooth; shell strong, chalky and white, LEUCOCHROA.

Genus CEPOLIS Montfort, 1810.

=*Cepolis* Montf.+*Eurycampta* Mart.+*Jeanneretia* Pfr.+*Hemitrochus* Swains.+*Coryda*, *Dialeuca* and *Leptoloma* Alb.+*Histrio* and *Plagioptycha* Pfr.+ *Cysticopsis* Mörch not Martens.

Shell globose-depressed or globose-conoid, umbilicate or imperforate, smoothish, rib-striate or spirally malleated; lip expanded (or simple and sharp), reflexed at columella, which is generally thickened with an oblique callus, sometimes a tooth; lip otherwise toothless but occasionally there is a callous fold within the mouth; varying from unicolored to conspicuously streaked or banded, the bands irregularly disposed. Type *C. cepa*, pl. 25, fig. 9. (See also pl. 56, figs. 1 to 9, and pl. 58, figs. 54 to 56).

Animal granulated above, without distinct dorsal grooves, facial furrows or tail-groove, the sole not tripartite except in color; mantle with small right and rudimentary left body-lappets. Right eye retracted between branches of genitalia.

Jaw high arched, with an obvious or slight median projection and sometimes a wide, vertical rib-like median convexity; *its surface smooth* or showing slight striæ (pl. 57, figs. 41 to 46).

Radula long, with comparatively few longitudinal rows of teeth (30. 1. 30 to 45. 1. 45). *Middle and lateral teeth having long, narrow basal plates, and short, broad middle cusps*, shorter than the basal plates, and with *no trace of side cusps*. Transition teeth developing the ectocone; marginal teeth tricuspid, *the ento- and meso-cones short*, coalescent at base, ectocone simple or bifid. (Pl. 57, figs. 40, 47 to 51).

Genitalia (pl. 52, figs. 12–16, 19, 21) characterized by a *long, slender penis* provided with a weak retractor or none, inserted low on penis and distally on the lung floor; *the apex of penis splitting into a long flagellum* and the *v. d.* Low on vagina or on atrium is borne *a long club-shaped dart sack, with constricted head*, which is *bound by a string of connective tissue to base of vagina;* at the base of dart sack the *glandular, flat, two-lobed, elongated* mucus gland is inserted. Spermatheca long, closely bound to upper end of uterus; *its duct very long, closely adherent to uterus*, convoluted on lower end of same, but free from vagina, near the base of which it is inserted. Notwithstanding the well developed dart sack, I found no dart in any of the numerous individuals of this genus examined.

Distribution, greater Antilles, Bahamas, Florida Keys.

See under *Plagioptycha* for notes on the fossil forms.

The prominent features of this group are (1) the smooth, high arched jaw with median projection, (2) the long radula with few longitudinal rows, middle and lateral teeth with long, narrow basal plates and short, broadly rounded mesocones, no side cusps, marginals with short ento-+mesocones, (3) the weak or even lacking retractor of the long penis, the club-shaped dart sack and two-lobed mucus gland; long, unbranched spermatheca duct, etc.

The only near ally of *Cepolis* is the genus *Polymita*, which inhabits the same tract. The latter has the same type of jaw and genitalia, but differs in the radula with over twice as many longitudinal rows of peculiarly modified teeth, all of them bearing three nearly equal cusps. From the Californian and Mexican *Epiphragmophora* species *Cepolis* differs in the very characteristic form of the dart sack, the short inner cusps of the marginal teeth, the ribless jaw, etc.

Part of the species of this genus are ground snails with dull brownish shells, but little variegated, as in the sections *Cepolis*, *Jeanneretia*, *Eurycampta*, *Plagioptycha;* part are arboreal, and in these the shell is generally bright in color, often with a rich and beautiful banded or streaked pattern, *Coryda*, *Hemitrochus* and *Dialeuca* being of this sort. A parallel series of variations is seen in the Philippine Island Cochlostylas, where we have also arboreal and terrestrial forms.

This genus is remarkably homogeneous in characters of the soft anatomy, which offers no divergence of more than specific value throughout the entire group. I have given on plates 52 and 57 drawings representing the anatomy of a sufficient number of the sectional groups to allow any malacologist to judge for himself of the literal truth of this statement. The *shells* afford characters for several sectional divisions, of which it must be said that although the typical species are quite different, intermediate forms reduce the diagnostic sectional characters to a minimum. This intergradation has caused me to disregard the fact that former authors have distributed the elements of my genus *Cepolis* far and wide throughout the *Helix* series; and I venture to predict that any one having a fairly complete collection of the species will endorse the views here advanced if he will bring the species together and observe the transition forms uniting the various sections. *Cepolis* is bound to

Jeanneretia by *C. squamosa, subtussulcata,* etc.; *C. exdeflexa* is a transition between *Jeanneretia* and *Eurycampta*, and is not far from some of the Plagioptychas, while *nemoralina, filicosta* and *maynardi* bridge the gap between *Plagioptycha* and *Hemitrochus.*

I am unable to find in *Hemitrochus* and *Polymita* any general system or plan in the distribution of bands, such as occurs in the five-banded Helices of Europe or in the epiphallogonous groups of Asia and Australia. I believe that the color schemes of the arboreal West Indian forms have been independently evolved, with the exception of the supra-peripheral band, which may possibly be homologous with that of *Campylaea, Tachea,* etc.

A prominent feature in some species of this genus is the tooth within the mouth of the shell, marked by an external pit. A similar structure occurs in *Solaropsis, Planispira, Neocepolis,* etc., but it does not seem to be of generic or even subgeneric value in any group.

The sectional divisions are as follows:

Cepolis.	Plagioptycha.
Jeanneretia.	Cysticopsis.
Eurycampta.	Hemitrochus.
	Coryda+Dialeuca.

Section *Cepolis* Montf., 1810.

Cepolis Montf., Conch. Syst. ii, p. 150 (type *nicolsinianum* Montf. =*cepa* Müll.); *Cepolum* Montf., *l. c.* p. 151.

Shell rather solid and of moderate or large size, imperforate or umbilicate, compact, globose-depressed, opaque, striate or malleated, 2 or 3 banded, the spire low, conic or convex; whorls less than 5, the last abruptly deflexed in front, *having a pit below the periphery a short distance behind the lip,* which inside the shell appears as *a callous fold a short distance within the outer lip.* Aperture quite oblique, truncate-oval, the lip expanded; columellar lip reflexed, *armed inside with a compressed or entering tooth.* Type *C. cepa,* pl. 25, fig. 9.

Soft anatomy unknown. Distribution, Hayti.

Differs from *Jeanneretia* mainly in the stronger columellar tooth and the constant deep pit behind the lip forming a callous fold within the mouth.

C. cepa Müll., v, 93.
impressa Blv.
nicolsinianum
C. trizonalis Grat., v, 93.
v. trizonella Pils., v, 94.
C. trizonaloides Brown, v. 95.
pimesoma Pils., v, 95.

Section *Jeanneretia* Pfr., 1877.

Jeanneretia PFR., Mal. Bl. xxiv, p. 7 ; Nomencl. Hel. Viv., p. 116, —PILSBRY, Man. Conch. v, p. 48. *Cf.* POEY, Memorias, pl. 6, f. 6. genitalia of *parraiana.*

Shell imperforate or umbilicate, globose-turbinate, light brown, generally with darker chestnut bands, two or three in number. *Whorls 5 to 6½, slowly widening,* the last deflexed in front and *constricted behind the lip;* aperture oblique, rounded-truncate; lip reflexed and thickened, the columellar margin straightened. Type *C. multistriata* Dh. (See pl. 58, figs. 54, 55, *C. parraiana*).

Jaw and radula unknown. Genitalia as in *Eurycampta* (pl. 52, fig. 21, *C. parraiana,* after Poey).

Distribution, Cuba ; one species, *C. squamosa,* is from Porto Rico ; they live under dead leaves and stones.

The group is allied to *Cepolis* and *Eurycampta,* its main distinctive features being the spirally lirate surface and the groove or constriction behind the reflexed lip.

C. multistriata Dh., v, 49.
circumtexta Fér.
vesica Lea.
bicincta Mke.
adjuncta Zgl.
v. pityonesica Pfr., v, 49.
C. wrighti Gundl., v, 49.
C. dermatina Sh., v, 50.
C. angulifera Mart.
C. parraiana Orb., v, 50.
v. parallela Poey, v, 51.
C. sagraiana Orb., v, 50.
C. subtussulcata Wright, v, 51.
C. squamosa Fér., v, 95.
macularia Lm.

Section *Eurycampta* Martens, 1860.

Eurycampta MART. in Alb., Die Hel., p. 127, type *H. bonplandi.*

Shell narrowly umbilicated, orbiculate convex, obliquely rugose-striate, with a satin like lustre; brown, uniform or with 1 to 3 bands above, one or none below the rounded periphery. Whorls 5 or less, the last unusually wide, deflexed in front. *Aperture large, transverse, oval;* peristome expanded and lipped, reflexed below,

the columellar margin often callously thickened within; ends of lip somewhat approaching. Type *C. bonplandi*, pl. 58, fig. 56.

Animal as described for *C. alauda*, but lighter colored.

Jaw solid, high arched, smooth except for slight striæ in places. (pl. 52, fig. 18, *C. bonplandi*).

Radula (pl. 52, figs. 20, 22, *C. bonplandi*) long, the middle and lateral teeth with long basal plates and short, rounded mesocones, no side cusps. Transition teeth developing an ectocone (fig. 22, central with two adjacent laterals and two transition teeth). Marginals of the usual tricuspid type (fig. 20).

Genital system as in *Coryda*, etc., but the retractor muscle is stouter, flagellum and mucus glands longer (pl. 52, fig. 19, *C. bonplandi*).

C. bonplandi Lam., iv, 82.
C. supertexta Pfr., iv, 82.
C. arctistria Pfr., iv, 82.
C. exdeflexa Pils., v, 198.
deflexa Pfr. not Braun.
C. poeyi Petit, iv, 83.
staminea Mke.
velutinata Bk.
C. bryanti Pfr., iv, 83.
C. desidens Rang, iv, 82.

Section *Coryda* Albers, 1850.

Coryda Alb., Die Hel., p. 100, for *alauda* and varieties.—*Histrio* Pfr., Mal. Bl., 1855, p. 185; 1877, p. 8, for *H. dennisoni*.—*Helicostyla* Beck, Index, p. 36, in part.

Shell depressed-globose, imperforate, *solid and strong, smooth, with deeply and abruptly deflexed last whorl*, very oblique, transversely oblong aperture, the lip expanded, thickened within, and having a conspicuous banded, obliquely streaked or dotted color pattern. Type *H. alauda* pl. 56, figs. 3, 4.

Animal of *H. alauda* blue-black, the sole light slate colored in the middle, not tripartite except in color. Foot long, granulated, without distinct longitudinal grooves on back and lacking facial grooves. Tail evenly and more finely granulated, acute behind. Mantle-edge thin, with a low right body-lappet and a minute left one. Right eye retracted between branches of genitalia.

Jaw (of *H. alauda* pl. 57, fig. 45) solid, highly arched, with a wide median projection, its surface entirely smooth.

Radula (of *H. alauda* pl. 57, fig. 49) long and narrow, with V-shaped rows according to the formula 24. 9. 1. 9. 24. Median teeth with long basal plates and short, broad mesocones, no side cusps.

Laterals similar but asymmetrical. Marginals developing a stout ectocone, and on the outer ones an entocone. The figure represents a middle tooth with 3 laterals and an inner and outer marginal.

Genital system with vestibule short; penis (pl. 52, fig. 13) very long and slender, without retractor, terminating in v. d. and a long flagellum. Vagina branching low into a very long and much twisted spermatheca duct which ends in a long spermatheca bound closely to top of uterus. Dart sack very large, dark colored, with a long fleshy white head, the apical portion separated by a constriction and united to base of uterus by a connective thread. Mucus glands two, long, leaf-like and glandular, uniting at their bases and inserted on the dart sack near its base. No dart found on the papilla in several specimens examined, which were of the "strobilus" variety (pl. 52, figs. 12, 13, *C. alauda*).

The species are few, and all from eastern Cuba except *H. circumornata* with its two slight color varieties from western Hayti. *H. dennisoni* is hardly more than a variety of *alauda*. The last named species is arboreal, and is frequently found living in the cargoes of bananas brought to Philadelphia and other eastern cities. Through the kindness of Mr. John Ponsonby I am able to fix at last the identity of the long lost *H. circumornata*, and the status of *vigiensis* and *stenostoma*.

C. alauda Fér., v, 42.
strobilus Fér.
avellana Fér.
purpuragula Lea.
mamilla Lea.
bizonalis Grat.
pudibunda Beck.
hebe Dh.
C. dennisoni Pfr., v, 44.
juliana Poey.
C. ovumreguli Lea, v, 44.
C. circumornata Fér., iv, 222.
v. vigiensis Weinl., v, 46!
v. stenostoma Pfr., v, 48!
C. lindoni Pfr., v, 45.
lindeni Pfr.
immersa Gundl.
C. bartlettiana Pfr., v, 45.
C. melanocephala Gundl., v, 46.
f. perelevata Pils.
C. nigropicta Arango, v, 47.

Section *Dialeuca* Albers, 1850.

Dialeuca Alb., Die Hel. 1850, p. 114 (for *H. nemoraloides*).—*Leptoloma* Alb.-Mart., Die Hel. 1860, p. 136 (type *H. fuscocincta*). —W. G. Binn., Ann. N. Y. Acad. Sci., iii, p. 96, jaw and dentition of *fuscocincta;* p. 107, dentition of *gossei*.

Shell imperforate, rather thin, more or less *trochoidal*, varying from high and pyramidal to low trochiform; lip thin, slightly expanded, a little widened and reflexed at the columella. Type *C. nemoraloides*, pl. 56, fig. 5. (See also *C. fuscocincta*, pl. 56, fig. 6).

Animal light colored or dark as in *H. alauda*. Jaw, dentition, etc., also as in *Coryda* (pl. 57, figs. 43, 48, jaw and dentition of *C. platystyla*).

This section might well be united to *Coryda*, from which it differs only in distribution and the somewhat thinner shell. The typical Dialeucas are from Jamaica, but a few species are from Navassa (*H. gaussoini*), and the Cayman Is. (*streatori, caymanensis*); and the closely allied *H. phœogramma*, of which I have seen a specimen in Ponsonby's collection, is not yet located.

C. conspersula Pfr., v, 38.
v. fuscocincta Ad., v, 39.
v. platystyla Pfr., v, 39.
v. virginea Ad., v. 39.
C. subconica Ad., v, 40.
gossei Pfr.!
C. jacobensis Ad., v, 41.
C. blandiana Ad., v, 41.
C. nemoraloides Ad., v, 40.
v. pulchrior Ad., v, 41.
gossei (C. B. Ad.), Pfr., Rv.
C. gaussoini Tryon, v, 197.
C. streatori Pils., viii, 240.
C. caymanensis Mayn., viii, 241.
C. phæogramma Pfr., v, 42.

Section *Hemitrochus* Swainson, 1840.

Hemitrochus Sw., Malacol., p. 331, type *H. hæmastomus=H. varians*.—Binney, Terr. Moll., v, p. 174, and Ann. N. Y. Acad. Sci., iii, p. 90 (jaws and teeth of *varians, troscheli, gallopavonis, rufoapicata, graminicola, milleri*).—*Polytœnia* Martens, Die Hel., p. 129, type *H. multifasciata*.—*Phœdra* Alb., Die Hel., p. 100.

Shell globose-conoid or globose-depressed, *solid*, smooth or rib-striate, *opaque, variegated with bands or dots*, the umbilicus narrow or closed; last whorl slightly descending. Lip blunt, simple or expanded, *thickened within*, reflexed at columellar insertion. Type *C. varians*, pl. 56, figs. 1, 2.

Jaw highly arched, with a median projection and sometimes a median rib-like convexity (pl. 57, fig. 41, *C. varians*. Pl. 57, fig. 46, *C. milleri*).

Radula having long, narrow basal plates and broad, short central cusps without side cusps on median and lateral teeth. Marginals

with a large split inner cusp and a simple or bifid ectocone (pl. 57, figs. 50, 51, *C. varians*).

Genital system having a long, slender penis branching into v. d. and a long flagellum, and with a thread-like retractor attached low, and inserted distally on the lung floor. Spermatheca duct free below, but firmly bound to uterus above, with a long spermatheca and a spiral twist in the duct near base of uterus. Dart sack long; mucus glands two, flat and glandular, inserted at base of dart sack. Eye stalk retracted between branches of genitalia (pl. 52, fig. 14, *C. varians* Mke.).

The shell in this section differs but little from that of *Coryda* and *Dialeuca;* and while quite distinct from the typical forms of *Plagioptycha*, there are a number of species so intermediate in character that they may be placed as well in one as in the other group. Anatomically there are no differences of more than specific worth between these groups, unless the larger (though still very weak) penis retractor of *Hemitrochus* be considered such. Many of the species are excessively closely allied.

There are two groups of species: the Cuban, consisting of compact forms of the type of *H. cesticulus;* the Bahama group varying from globose-conical like *H. varians* to depressed and rib-striate, *H. maynardi.*

Species of Florida and Bahamas.

C. varians Mke., v, 24.
carnicolor Pfr.
submeris Migh.
rhodocheila Binn.
polychroa Binn.
hæmastomus Sw.
C. xanthophaës Pils., viii, 242.
C. milleri Pfr., v, 25.
C. constantior Weinl., v, 26.
C. caribæa Weinl., v, 26.
C. gallopavonis Val., v, 27.
v. calacaloides Pils., v, 28.
C. troscheli Pfr., v, 28.
tenuicostata Dkr.
v. calacala Weinl., v, 29.
C. multifasciata W. & M., v, 30.
f. polytæniata Pils., v, 30.
C. filicosta Pfr., v, 30.
C. brownii Pils., v, 29.
C. maynardi Pils., viii, 241.

Cuban Species.

C. gilva Fér., v, 31.
corrugata Pfr.
v. tephrites Morel., v, 31.
C. fuscolabiata Poey, v, 34.
subfusca Poey not Bk.
v. morbida Morel., v, 35.

C. lucipeta Poey, v, 32.
picturata Poey not Ad.
lepida Poey.
bellula Poey.
penicillata Poey not Gld.
newcombiana Poey.
v. velasqueziana Poey, v, 32.
v. cesticulus Gundl., v, 33.
C. maculifera Gut., v, 35.
C. sauvallei Arango, v, 37.
C. comta Gundl., v, 34.
C. amplecta Gundl., v, 35.
C. rufoapicata Poey, v, 36.
C. graminicola C. B. Ad., v, 36.

Section *Plagioptycha* Pfr., 1856.

Plagioptycha Pfr., Mal. Bl., 1856, p. 135 (for indistincta, albersiana, duclosiana, bahamensis, strumosa, loxodon, monodonta).—Mart. in Alb. Die Hel., p. 145 (type *H. loxodon*).—W. G. Binney, Ann. N. Y. Acad. Sci., iii, p. 95, jaws and dentition of loxodon, albersiana, monodonta, duclosiana, diaphana, macroglossa.

Shell umbilicate or imperforate, *thin*, depressed-globose or depressed, the last whorl deflexed in front. Aperture transversely oblong or lunate; outer lip expanded or simple; *and either on the floor of the whorl within the mouth, or on the columellar lip, there is an oblique nodule or fold of callus*, sometimes reduced to a slight trace only. Type *C. loxodon* Pfr. (See pl. 56, figs. 8, 9, *C. duclosiana*).

Animal light colored, externally similar to *Hemitrochus*.

Jaw high arched, with a median projection (pl. 57, fig. 42, *C. salvatoris*).

Radula (pl. 57, fig. 47, *C. salvatoris*) similar to that of *Hemitrochus*, but with the cusps rather more acute.

Genital system as described for *Hemitrochus* (pl. 52, fig. 15, *C. salvatoris*).

Plagioptycha is probably nearest to the ancestral forms whence the modern sections of this genus arose. Its habits are terrestrial and the dentition is somewhat less abnormal than in *Coryda* and typical *Hemitrochus*. Moreover, characteristic forms of *Plagioptycha* are found in the Miocene Silex Beds of Tampa, Florida, (*H. latebrosa* Dall, *instrumosa* Dall), with other species (*H. crusta* and *H. diespiter* of Dall) which would probably be classed in the modern section *Eurycampta*, although it is obvious that these latter Miocene forms are more intermediate between *Eurycampta*, *Jeanneretia* and *Plagioptycha* than any living species. In the Miocene

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we are evidently near the horizon where the paths of the various sections of the genus *Cepolis* diverged, although the better defined forms of the genus no doubt have older roots.

The species of *Plagioptycha* are numerous and especially characteristic of the Bahamas, extending south to Hayti and the Virgin Islands. In Miocene times they extended to the (then) island of Florida, but later became extinct there, for the present Floridian land shell fauna is not directly descended from that of the Miocene island. Some forms of *Plagioptycha* approach *Hemitrochus*, and others are near *Cysticopsis*, so that the grouping, as in many of these sectional divisions, is somewhat arbitrary.

Umbilicate species, the columellar lip expanded, not adnate to base (Bahamas).

C. indistincta Fér., v, 14.
v. disculus Dh., v, 15.
v. chromochila Pils., v, 15.
C. strumosa Pfr., v, 15.
C. rüsii Pfr., v, 16.
C. platonis Pfr., v, 16.
C. albersiana Pfr., v, 17.
C. loxodon Pfr., v, 17.
C. bahamensis Pfr., v, 18.
v. holostoma Pils., v, 18.
C. sargenti Bld., v, 18.
C. duclosiana Fér., v, 19.
v. salvatoris Pfr., v, 19.
v. abacoensis Mts., v, 20.
C. macroglossa Pfr., v, 20.

Imperforate species, with adnate columellar lip (Hayti to Virgin Is.).

C. monodonta Lea, v, 21.
v. acuminata Pfr., v, 21.
haitensis W. & M., v, 21.
C. nemoralina Pet., v, 22.
f. intensa Pils., v, 22.
C. diaphana Lam., v, 22.
C. santacruzensis Pfr., v, 23.
C. phædra Pfr., v, 23.
justi Pfr.

Section *Cysticopsis* Mörch, 1852.

Cysticopsis Mörch, Catal. Yoldi, p. 2 (proposed for *cubensis* Pfr. only).—Pilsbry, Man. Conch. v, p. 10, Cuban species.—Not *Cysticopsis* Martens, Die Hel. 1860, p. 144!

Shell globose-depressed, *thin*, semitranslucent, unicolored or spirally banded and dotted, the last whorl *not descending in front;* aperture large, broadly lunate, *the lip thin, not in the least expanded* or reflexed, dilated and appressed at the umbilical insertion. Type *C. cubensis* Pfr. pl. 56, fig. 7.

Animal light colored, otherwise as in *Coryda*. Jaw high arched, smooth, with a large median projection (pl. 57, fig. 44, *C. cubensis*).

Radula long. Teeth with long, narrow basal plates, the median and lateral teeth without side cusps, transition and marginal teeth with an ectocone, the meso- and ento-cones united into a large bifid cusp (pl. 57, fig. 40, *C. cubensis*). The teeth of *pemphigodes* figured by Binney are of the same type, but with shorter cusps.

Genitalia (of *C. cubensis*, pl. 52, fig. 16), as in *Hemitrochus*, except that I see but one lobe to the mucus gland; the very long penis is apparently without retractor. Possibly the second lobe of the mucus gland was inadvertently removed in my dissection.

Mörch, in his original publication of this group, mentioned only one species, *H. cubensis* Pfr. The authors of the second edition of Die Heliceen were therefore not justified in naming *H. tenerrima* as type of *Cysticopsis*, and excluding *cubensis* from the roll of its members. On an earlier page of this work (p. 65), the writer has separated the Jamaica species formerly referred to this genus, and has shown them to belong to a separate genus, *Zaphysema*, near the *Sagda* group. The external features of the animal, its jaw, teeth and genitalia, all support this division.

Cysticopsis is allied on one side to the Cuban band-dotted forms of Hemitrochus, and on the other to the group of Plagioptychas like *diaphana*.

C. cubensis Pfr., v, 10.
lanieriana Orb.
trifasciella Beck.
pictella Beck.
N. pulchella Beck.
penicillata Gld.. v, 33.
nœvula Morel., v, 34.
C. comes Poey, v, 11.
C. letranensis Pfr., v. 11.
C. auberi Orb., v, 11.
C. pemphigodes Pfr., v, 12.
pelliculata Poey.
C. lescaillei Gundl., v, 13.
C. luzi Arango, v, 13.
C. lassevillei Gundl., v. 14.
C. pellicula Fér., v, 14.
C. jaudenesi Cisn., v, 14.
C. hjalmarsoni Pfr., v, 12.

Genus POLYMITA Beck, 1837.

Polymita Beck, Index Moll., p. 44 (*picta, globulosa, versicolor, carnicolor*).—Gray, P. Z. S., 1847, p. 171, type *H. picta*.—Martens, Die Hel., 1860, p. 145, type *H. muscarum*.—W. G. Binney, Ann.

N. Y. Acad. Sci. iii, p. 89 (Jaw and dentition).—Poey, Memorias sobre la Hist. Nat. Cuba, ii, pl. 7, f. 5.—Pilsbry, Man. Conch., v, p. 52.

Shell *subglobular, brilliantly colored*, rather thin but solid, imperforate; whorls few (about 4), the last but little deflexed; aperture rounded, slightly lunate, *the peristome simple, not expanded or reflexed* except at axis, where it is reflexed and adnate over the umbilical region; axis solid. Type *P. picta*, pl. 56, fig. 10.

Animal (of *P. picta*) black above, slaty below; evenly granulated throughout, without dorsal grooves, facial groove or foot margin, the tail rounded above, not grooved; sole not in the least divided, mantle edge thickened but without lobes.

Jaw arcuate, moderately solid, *smooth* (Pl. 51, fig. 8, *P. picta*).

Radula short and wide, *the teeth all of the same form, and in* v-*shaped rows*, formula about 85.1.85. Basal plates long and narrow; *cusps situated far backward, and projecting well over the posterior margin; all teeth tricuspid*, the three cusps united into a broad, tridentate gouge-shaped cutting edge. (Pl. 51, fig. 5, central with four lateral teeth; fig. 6, group of outer laterals; fig. 7, two extreme marginal teeth of *P. picta*).

Genital system (pl. 51, fig. 4, *P. picta*) altogether like that of *Cepolis*. The vagina is long, with a long stalked spermatheca; dart sack large, its head marked off by a constriction and united by connective tissue with the vagina; at root of d. s. there is a mucus gland composed of two oval, flat glandular lobes. Penis slender, with a long flagellum, and apparently no retractor muscle; eye-stalk retracted between branches of genitalia.

Distribution, Cuba. Habits arboreal.

The shell in this group resembles that of *Hemitrochus*, except that the lip is neither expanded nor thickened within. The genital system is entirely that of *Hemitrochus*. The radula is excessively peculiar in having the side cusps as long as the middle cusp and united with it to form a broad, tridentate gouge, all three cusps being subequally developed on all the teeth.

This type of radula may be compared with that of *Orthalicus, Oxychona, Papuina*, and especially with *Amphidromus;* all being arboreal genera, which have independently evolved the same general type of teeth.

P. picta Born, v, 53.
venusta Gmel.
sulphurosa Morel., v, 54.
L. tiara Martyn.
P. versicolor Born., v, 54.
? *pictoria* Perry.
? *cincta* Perry.
P. muscarum Lea., v, 54.
globulosa Fér.
carnicolor Orb.
v. subbrocheri Pils., v, 55.
P. brocheri (Gut.) Pfr., v, 55.
brocheroi Arango.

Genus OXYCHONA Mörch, 1852.

Oxychona Mörch, Cat. Yoldi, p. 14, type *H. bifasciata*.—Pilsbry, Man. of Conch., v, p. 128.—Martens, Biol. Centr. Amer., Moll., p. 152.—*Geotrochus, Leptoloma, Corasia, Axina* and *Eurycratera* of authors.—*Leptarionta* Crosse & Fischer, Moll. Mex. i, p. 253.

Shell rather shining, *thin and light colored*, with spiral brown bands, umbilicate or closed, the spire conic or depressed and merely convex,the last whorl varying from acutely keeled to subangular. *Surface smoothish*, often microscopically striate or granular. Aperture oblique, the lip expanded or reflexed, rather thin, not toothed. Type *O. bifasciata*, pl. 45, fig. 8. (See also pl. 45, figs. 1, 2, *O. costaricensis*. Pl. 45, figs. 3, 4, 5, *O. altispira*. Pl. 45, figs. 9, 10, *O. trigonostoma v. stolliana*.)

Animal (of *O. trigonostoma*, pl. 45, figs. 9, 10) quite elongated, the tail surmounted by a conspicuous serrate keel.

Jaw (of *O. bifasciata*, pl. 51, fig. 11), rather thin, arcuate, with no median projection, having about 17 unequal ribs distributed over its entire extent and denticulating the margin.

Radula (of *O. bifasciata*, pl. 51, fig. 10, central with 6 adjacent laterals, fig. 9, 7th to 13th laterals, with one marginal, and fig. below the latter, a lateral seen in profile) pavement-like, with v-shaped rows of nearly similar teeth. Centrals with an oblong squarish basal plate bearing one cusp springing from its middle, spreading into a spatulate form, and projecting far over the posterior end of of the basal plate on all sides. Laterals similar, but having the entocone indicated by a notch in the basal plate near its posterior angle, and bearing a minute basal ectocone. Outwardly, this ectocone increases in size, and becomes split on the marginal teeth, which are otherwise like the laterals.

Distribution, Brazil to Mexico. Habits arboreal, as far as known.

The prominent features of this group are the smooth, thin, light-colored and banded shell which is usually of a markedly trochiform contour, but sometimes depressed, the periphery angular; the ribbed jaw; the extremely peculiar radula, with enormously widened and enlarged middle cusps, and minute, basal side cusps. When the radula is torn, the teeth part readily along their lateral faces, but adhere in chain-like longitudinal rows.

The radula, as well as the jaw and shell, is comparable to that of *Papuina* (*cf.* p. 137, pl. 37, fig. 10), but although the superficial resemblance is great, the two are really totally distinct, the broad cusps of *Papuina* being formed by the united ento-, meso- and ectocones, whilst in *Oxychona* the mesocone only is modified, the side cusps becoming obsolete. *Polymita* also has a slightly similar but morphologically different dentition. The peculiar type of teeth in these three genera has evidently been independently evolved in each, from the usual tricuspid type. It seems to be correlated with arboreal habits. Compare also the radula of *Otostomus*.

The affinities of *Oxychona* are uncertain; but it will probably prove to be a member of the Belogona, distinguished from *Helix* by its *Papuina* or *Corasia* like shell, and the peculiar teeth. Probably in this group, as in *Papuina*, some species will be found to have a more normal type of dentition. The Mexican forms which have been placed in this group are still unknown anatomically, but the animal of *O. trigonostoma* has been figured with a toothed keel on the tail, such as occurs in the genus *Lysinoe*.

Messrs. Crosse & Fischer proposed the section *Leptarionta* for two species, *bicincta* and *flavescens;* but as they state that they had not seen *flavescens*, their group was evidently founded on *bicincta*, the first species described by them.

The first four species are from Brazil; the others are from Guatemala and Costa Rica to the province of Vera Cruz, E. Mexico.

O. bifasciata Burrow, v, 129.
pyramidella Spix, Wagner.
bosciana Fér.
blanchetiana Moric.
O. lonchostoma Mke., v, 130.
O. gyrina Val., v, 131.
O. pileiformis Moric., v, 131.
O. zhorquinensis Ang., v, 132.
O. trigonostoma Pfr., v, 132.
f. elevatoconica C. & F.
lalliana Tristr.
f. salleana Pfr.
obscura C. & F.
f. intermedia C. & F.

O. trigonostoma Pfr., v, 132.
f. subunicolor C. & F.
stolliana Mts.
f. freytagiana Dohrn.
O. altispira (Dohrn) Mts.
O. bicincta Pfr., iv, 75.
O. guillarmodi Shutt., v, 133.
O. costaricensis Roth, v, 134.
f. virginea Anc.
f. steiniana Anc.
f. boucardi Ang.
O. adela Ang., v, 135.

Genus LYSINOE H. & A. Adams, 1855.

Aglaja ALB., Die Hel., 1850, p. 107, sole species *H. ghiesbreghti.* —*Aglaia* Alb., v. MART., Die Hel., 1860, p. 122, in part, exclusive of "type" and all but first species. Not *Aglaia* Renier, 1804, Eschscholtz, 1825, or Swainson, 1827.—*Lysinoe*, H. & A. AD., Gen. Rec. Moll. ii, p. 203, for *ghiesbreghtii* and *hogoleuensis* (June, 1855). —v. MARTENS, Biol. Centr. Amer., Moll., p. 145.—*Odontura* FISCHER & CROSSE, Miss. Scient. Mex., Moll., pp. 211, 242, 1870, for *ghiesbreghti* and *eximia.*—*Humboldtiana* v. IHERING, Morphol. u. Syst. des Genitalapparates von Helix, in Zeitschr. f. wissenschaftl. Zoologie, liv, p. 172, 1892, type *H. humboldtiana.*

See for anatomy, FISCHER & CROSSE, *l. c.*; W. G. BINNEY, Bull. Mus. Comp. Zool., v, p. 336, pl. 2, f. I. K.; v. MARTENS, *l. c.*, pl. 8, f. 4.

Shell large, globose or depressed globose, beset with granules and sometimes hairs, brownish or yellowish with dark spiral bands; umbilicus open or partly covered; aperture lunate, lip margins more or less reflexed, at least the columellar margin. Type *L. ghiesbreghti*, pl. 45, fig. 7. See also pl. 58, fig. 75, *L. humboldtiana* var. *badiocincta.*

Animal large, coarsely granulose, *the tail surmounted by a knobbed or serrate keel* (pl. 45, fig. 7, *H. ghiesbreghti*).

Jaw arcuate, solid, with 6–11 *spaced* ribs (pl. 60, fig. 9, *L. eximia*).

Radula having unicuspid median teeth, the stout cusp shorter than the basal plates. Lateral teeth with a small ectocone. Marginals haxing a long oblique bifid inner cusp and a small ectocone, (pl. 60, fig. 5, *L. humboldtiana*).

Genital system having the retractor and epiphallus inserted at apex of the short penis; epiphallus continued in a long flagellum. Spermatheca duct varying from moderate to very long, without diverticulum. Vagina bearing *two equal, symmetrically placed dart sacks*, above the insertion of which *three club-shaped mucous glands*

are independently inserted on the vagina. Darts unknown. (Pl. 60, fig. 8, *L. ghiesbreghti*).

The three species present the same type of genitalia. The shell is similar to *Campylœa* or *Epiphragmophora*, but the doubling of the dart sack, and the number of the mucus glands, independently inserted on vagina, are features which can only be compared to the Xerophiloid and Fruticicoloid groups. The serrate keel of the tail is a curious feature of this group, but something like it occurs also in *Oxychona trigonostoma*, the internal anatomy of which is unknown. The jaw and teeth of *Lysinoe* are of the normal Helix form. Distribution, Southern Texas (*humboldtiana*) to Guatemala and Honduras (*ghiesbreghti*).

The name *Aglaja* Alb. is thrice preoccupied in zoology. *Lysinoe* was proposed for two species, the second of which, *Helix hogoleuensis* Le Guill., belongs to the prior genus *Rhyssota* Alb. We therefore follow von Martens' excellent precedent in considering *H. ghiesbreghti* the type of *Lysinoe*. *Helix humboldtiana* agrees entirely with *ghiesbreghti* in anatomy, so the sectional name, *Humboldtiana* v. Iher., becomes a synonym. *Odontura* is preoccupied.

L. ghiesbreghti Nyst., iv, 75.
- *f.* subaurantia, v. Mart.
- *f.* strubelli Bttg.
- *f.* fulvostraminea, v. Mart.
- *f.* bizona, v. Mart.
- *f.* rufozonata v. Mart.

L. eximia Pfr., iv, 75.
- v. stolli, v. Mart.

L. humboldtiana Fér., iv, 260.
- v. hegewischi v. Mart.
- v. högeana v. Mart.
- v. buffoniana Pfr.
  - *matronula* Uhde.
- v. badiocincta Wiegm.

Genus GLYPTOSTOMA Bland & Binney, 1873.

Glyptostoma Bld. & W. G. B., Proc. Acad. Nat. Sci., Phila., 1873, p. 244 (June 3, 1873). See for anatomy, Binney, *t. c.* pl. 1, f. 1, 3; Am. Journ. Conch., vii, p. 190, pl. 17, f. 3, 4; Proc. Acad., Phila., 1875, p. 219, pl. 16, f. 4, pl. 13, f. 6, and 1876, p. 190, pl. 6, f. h.; Terr. Moll., v, p. 373, pl. 14, f. d.

Shall discoidal with slightly convex spire of about 6 whorls and broadly open umbilicus showing all the whorls; smoothish, dark and opaque; last whorl rather tubular, hardly descending in front. Aperture round-lunar, oblique, *the lip simple and acute,* neither

thickened nor expanded, margins approaching; *parietal wall densely spirally striated.* Type *G. newberryanum*, pl. 31, figs. 36, 37.

Jaw low, wide, slightly arcuate, without median projection, with about 15 ribs extending nearly to the ends. (Pl. 31, fig. 38.) Radula long and narrow, formula 30.17.1.17.30; basal plates of median and lateral teeth long, the mesocones about the same length, side cutting points developed. Marginal teeth with shortened basal plates, the inner cusp rather short and stout, ectocone small (pl. 31, fig. 40, middle with 1st lateral, 23d, 24th, 25th, 37th and 47th marginal teeth).

Genitalia (pl. 31, fig. 39) characterized by a stumpy penis with short, obtuse flagellum; dart sack obsolete or absent, but one club-shaped mucus gland, like that of *Epiphragmophora fidelis* present; spermatheca duct long, bound to oviduct, but free above and below.

A monotypic genus, allied to *Epiphragmophora*, but differing in the shell, which has much the form of the typical *Zonites* or *Patula*, in the wide many-ribbed jaw, and in the genital system, which apparently lacks a dart sack, although the mucus gland is retained. Further examination is needed, to ascertain whether any trace of the dart sack is present, for I suspect this will prove to be the case. The single species is common around San Diego, on southerly exposed hill-sides under rocks.

G. newberryanum W. G. B., iii, 110. Los Angeles, Cal., to Todos Santos Bay, L. Cal.

Genus EPIPHRAGMOPHORA Döring, 1875.

Epiphragmophora Doring, Bol. Acad. Nacional de Ciencias Cordova i, p. 446, for *H. hieronymi* and *H. cuyana.* + *Angrandiella* Ancey, Conchologists' Exchange, i, p. 20, Nov. 1886, type *H. angrandi.* + *Pœcilostola* Anc., *l. c.*, type *H. farrisi* (not *Pœcilostola* Stål, 1870, Hemiptera, *Pœcilostola* Chaud., 1871, Coleoptera, or *Pœcilostolus* Günth., 1863, Reptilia) = *Pilsbrya* Anc., *t. c.*, p. 54, Apr., 1887, same type. + *Helminthoglypta* Anc., Conch. Exch., i, p. 76, June, 1887, type *H. tudiculata.* + *Micrarionta* Anc., Le Naturaliste, Dec., 1880, p. 334, type *H. facta.* + *Aglaia* of American authors, not Albers. + *Arionta* of authors, not Leach + *Lysinoe* Pils., check list, not H. & A. Adams + *Campylæa* (American species) v. Ihering, Morphol. u. Syst., not of Beck. + *Euparypha* of American authors, not Hartmann.

?+ *Cœlospira* Anc., Conch. Exch., i, p. 20, type *H. macneili* (not *Cœlospira* Hall, 1858, Brachiopoda)=*Averellia* Anc., *l. c.*, p. 54, Apr., 1887, same type. + *Trichodiscus* Strebel, Beitr. Mex. Land- und Süssw.-Conch., iv, p. 32, 1880 (not of Ehrenberg, Infusoria)= *Trichodiscina* v. Martens, Biol. Centr. Amer. Moll., p. 133, March, 1892; type *H. coactiliata.*

See for anatomy W. G. Binney, Terr. Moll., vol. v (figures not always reliable!).—Semper, Reisen, etc., p. 242.—Döring, Bol. Acad. Nac. Sci., Cordova, i, and Estudos Sist. y Anat. sobre los Mol. pulm. de los poises del Plata, Periodico Zool., i, 1875, p. 129–204.—Strebel & Pfeffer, Beitr. Mex. Moll., pt. iv.—Heynemann, Mal. Bl., xv, pl. iv, fig. 4.

Shell varying from globose to subdiscoidal, rarely keeled, umbilicate or imperforate, with 4 to 7 whorls. Surface generally decussated, malleated or hirsute; the texture varying from corneous to chalky; generally variegated, having a supraperipheral band, sometimes 3-banded. Aperture lunar, the lip expanded or reflexed, dilated at columellar insertion, toothless; but a few species have a columellar nodule or internal plicæ. Type *E. hieronymi* Döring, pl. 59, fig. 77. (See also pl. 58, figs. 57 to 74).

Animal granulated as usual, with a pair of dorsal grooves and no distinct facial grooves, the tail rounded above, not keeled nor grooved. Sole undivided (pl. 45, fig. 6, *E. fidelis*; pl. 59, fig. 76, *E. nickliniana*, showing atrium extruded, and the characteristic granulation of foot, not well shown in the fig. of *E. fidelis*). Right eye retractor passes between branches of genitalia.

Jaw arched, with 3 to 8 stout ribs denticulating the margins (pl. 59, fig. 78, *E. semiclausa;* fig. 80, *areolata;* fig. 83 *nickliniana;* fig. 84, *fidelis;* fig. 85, *arrosa;* pl. 52, fig. 17, *E. cordovana*).

Radula characterized by median and lateral teeth without side cusps; marginals with the entocone+mesocone forming a long compound cusp, ectocone simple, never bifid. (Pl 60, fig. 10, *E. fidelis.* Fig. 7, *E. nickliniana.* Fig. 4, *E. areolata*).

Genitalia characterized by a slender penis continued in an epiphallus which bears the retractor; flagellum present. Dart sack short, its apex neither constricted nor attached, containing a two-edged dart, pl. 59, fig. 82, *E. mormonum.* Mucus gland either (1) single and club-shaped, seated on dart sack, pl. 59, fig. 81, or (2) single but dividing above into two bulb-bearing branches, pl. 59,

figs. 79, 87, or (3) double and glandular with threadlike ducts inserted at root of dart sack, one gland bound to dart sack, one to vestibule or base of penis, pl. 59, fig. 89, glands torn from their attachments. The spermatheca is globose, its duct often bearing a diverticulum.

Distribution, British Columbia southward to Argentina, mainly confined to the Pacific drainage, but spreading to the Gulf slope in Central America.

The genus *Epiphragmophora*, while allied to the Helices of Japan, is distinguished from them by the non-sacculated mucus glands and some shell characters. It is also allied to *Cepolis*, a West Indian genus which is characterized by its flat, two-parted mucus gland, peculiarly formed dart sack attached at apex to vagina, and ribless jaw. The middle American genus *Lysinoe* is similar to *Epiphragmophora* in features of the shell, but differs widely in the duplication of the dart sack (elsewhere developed only in *Hygromia* and *Helicella*), in the *three* club-shaped mucus glands independently inserted on the vagina, and in the serrate keel of the tail. A still nearer ally of *Epiphragmophora* is *Glyptostoma*, characterized by the simple acute lip of the peculiar shell, and the decadence of the dart sack.

The diverticulum of the spermatheca duct is present or absent in closely allied species, just as we find it in other genera. The shell varies so much that no generic diagnosis can be framed from it alone, which would cover all forms of *Epiphragmophora* and still exclude species of other groups. This difficulty is not encountered when we diagnose from the soft anatomy, which presents extremely characteristic and readily recognized features.

Dr. von Ihering, in his essay on *Helix*, refers this New World series to *Campylœa;* but as the other groups studied by him belong to the *Belogona siphonadenia* of my arrangement, he was not aware of the value of the characters upon which the Belogona are split into two great groups, and his knowledge of the American forms was wholly second-hand—from *figures*, not *dissections*. I feel confident that if v. Ihering had actually dissected American and East Asiatic types, he would have taken a different view, and one more in accordance with the opinions of Semper and the writer.

The members of this genus have hitherto been placed in *Arionta*, *Euparypha* and *Aglaia* by American authors. Semper, as long ago as 1880 (Reisen im Archip. Phil. (2) iii, Landmoll., p. 245), emphat

ically stated his belief that the American should be separated from the European "Ariontas;" and my own studies have converted me to the same opinion, although before my dissections were begun, I had thought otherwise. It is sufficient to say here that in the American, as in the East Asiatic types of belogonous Helices, the mucus glands are globular or flat bodies of glandular texture, inserted upon the dart sack or at its base; in the European forms these glands are always tubes of equal diameter throughout their length, and inserted upon the vagina above the dart sack. If my division of the belogonous Helices upon this character be correct, *Helix, Helicigona* (-*Campylæa*+*Arionta vera*), *Fruticicola, Xerophila* etc., are all more nearly allied to each other than any European Helices are to the American Ariontas, so-called.

The American types are closely allied to the large Helices of Japan and China in anatomical features. The resemblance in shell characters of the Californian and European species is astonishing, but I do not doubt that it is due to purely secondary modification, which has moulded the shells to a deceptive likeness, but left unchanged the genitalia to tell more faithfully the story of their lineage.

Synopsis of Sections of Epiphragmophora.

Although not nearly so homogeneous a group as Cepolis, Helix or Helicigona in anatomy, this genus exhibits but little modification in shell characters. The sections here admitted, although natural groups, have but little systematic rank. *Averellia* and *Trichodiscina* are not sufficiently known anatomically for us to be certain that they belong here, but the probabilities are strong that they do.

**South American forms.*

Section EPIPHRAGMOPHORA Döring. Shell umbilicate, brown, calcareous, with one supraperipheral band, peristome expanded, nearly circular. *Epiphragm solid, calcareous;* jaw four ribbed; dart sack lengthened, with two globose, stalked mucus glands; spermatheca short-stalked. Type *H. hieronymi*, pl. 59, fig. 77; (see also *E. cuyana*, pl. 58, figs. 68, 69.)

Section PILSBRYA Ancey. Shell imperforate or umbilicate, malleated, similar to that of Helminthoglypta. Epiphragm membraneous. jaw 4–5 ribbed (pl. 59, fig. 78, *E. semiclausa*); median

and lateral teeth without side cusps; marginals tricuspid; dart biangulate; mucus glands as in Epiphragmophora. Type *E. farrisi*, pl. 58, figs. 58, 59. See also *E. petasensis*, pl. 58, figs. 60, 61.

We regret to say that this group is not well distinguished from the preceding.

Section ANGRANDIELLA Anc. Shell depressed, umbilicated, with a toothlike prominence within the basal lip, marked by an external pit. Type *E. angrandi*, pl. 58, fig. 57.

***Central American and Mexican forms.*

Section AVERELLIA Ancey. Shell discoidal with concave spire and wide umbilicus, hirsute, the last whorl deeply descending in front; scrobiculate behind the aperture above and below; aperture subhorizontal, biplicate within, peristome narrowly expanded. Type *E. macneili* Crosse.

Section TRICHODISCINA Martens. Shell depressed, with open umbilicus and deflexed last whorl, granulate and hairy; aperture small, oblique or subhorizontal, toothless, the lip expanded. Jaw ribbed (pl. 52, fig. 17, *E. cordovana*). Type *E. coactiliata*, pl. 58, figs. 70, 71.

*** *North American forms.*

Section MICRARIONTA Ancey. Shell globose or globose depressed, one or many banded, the bands sometimes interrupted; substance rather calcareous. Mucus glands two, with threadlike ducts, one lengthened, adherent to and spread upon the vagina or base of penis, its duct entering vagina at root of dart sack; the other shorter, usually adherent to dart sack, on base of which its duct enters. Radula with rather short basal plate and wide mesocones, no ectocones on middle and lateral teeth. Marginals with a subbifid inner and simple outer cusp (pl. 60, fig. 4, *areolata*). See pl. 59, figs. 89, *E. areolata*. Type *E. facta gabbi*, pl. 58, figs. 73, 74. (See also *E. areolata*, pl. 58, figs. 66, 67.)

Section HELMINTHOGLYPTA Ancey. Shell globose or depressed, its surface either simply striated, decussated or malleated. Mucus gland one, split into two bulb-bearing branches, and inserted on the dart sack. (Pl. 59, fig. 47, *E. arrosa*; fig. 87, *E. traskii* v. *cayamacensis*; fig. 88, *E. nickliniana*). Radula with basal plates longer than cusps of median teeth, middle and lateral teeth without side

cusps, marginals with a bifid inner and simple outer cusp (pl. 60, fig. 7, *E. nickliniana*). Type *E. tudiculata*, pl. 58, figs. 62, 63.

Section MONADENIA Pilsbry. Shell with depressed body whorl, often more or less keeled or angular, the spire either low or conical. Surface with growth striæ. Mucus gland one, undivided, club-shaped, its terminal portion glandular, and inserted on the dart sack. (Pl. 59, fig. 81, *E. fidelis*; pl. 59, figs. 82, 86, *E. mormonum*). Radula with no side cusps on middle, lateral or transition teeth; marginals with bifid inner and simple outer cusp (pl. 60, fig. 10, *E. fidelis*.) Type *E. fidelis*, pl. 58, fig. 72. See also pl. 58, figs. 64, 65, *E. mormonum*.

SOUTH AMERICAN SPECIES. Epiphragmophora+Pilsbrya.

E. alsophila Phil., iv, 78.
E. audouini Orb., iv, 81.
v. oresigena Orb.
E. claromphalos Dev. & Hpe., iv, 80.
v. mesomphalos Mor.
E. clausomphalos Dev. & Hpe., iv, 78.
E. cuyana Strob., iv, 78.
E. diluta Pfr., iv, 80.
E. estella Orb., iv, 78.
v. tucumanensis Dör., iv, 78.
E. farrisi Pfr., iv, 77.
E. gueinzii Pfr.
E. hidalgonis Dör.
E. hieronymi Dör., iv, 78.
E. higginsi Pfr., iv, 79.
farrisi Hig., not Pfr.
E. huancensis Ph., iv, 79.
E. jaspidea Pfr., iv, 79.
platysoma Pils., vi, 104.
E. macasi Higg., iv, 81.
E. monographa Dör.
E. patasensis Pfr., iv, 81.
f. minor Pfr.
E. pelliscolubri Ph., iv, 80.
E. semiclausa Mts., iv, 80.
E. trenquelleonis Grat., iv, 82.
E. trigrammephora Orb., iv, 80.
E. tschudiana Ph., iv, 77.
E. yocotulana Dör., iv, 81.

(*Shell depressed, umbilicate, with a tooth within the basal lip.* Angrandiella.)

E. angrandi Morel., v, 96. Peru.

MIDDLE AMERICAN SPECIES.

(*Shell hirsute, depressed, with large umbilicus, 2-grooved behind lip and 2-plicate within.* Averellia.)

E. macneili Crosse, v, 96. Costa Rica.

(*Shell depressed, subdiscoidal, with wide umbilicus; hirsute. S.-E. Mexico, Cent. Amer.* Trichodiscina.)

E. coactiliata Fér., iii, 49.
tœniata Nyst.
nystiana Pfr.
bridgesi Try., not Newc.
parkeri Tryon.
E. cordovana Pfr., iii, 49.
? obsita Pfr.
E. suturalis Pfr., iii, 49.
v. pressula Morel., iii, 50.
almonte Tristr.
almonteana F. & C.
E. oajacensis Koch, iii, 50.
E. sumichrasti C. &. F., iii, [184.
E. sargi C. & F., iv, 80.

NORTH AMERICAN SPECIES.

(*Shell with conic or low spire, often keeled or angular.* Monadenia.)

E. fidelis Gray, iv, 69.
nuttalliana Lea.
f. minor W. G. B.
f. flava Hemph.
f. subcarinata Hemph.
v. infumata Gld., iv, 70.
E. mormonum Pfr., iv, 70.
v. hillebrandi Newc., iv, 70.
E. circumcarinata Stearns, iv, 70.

(*Shell globose or depressed, smooth, malleated or granose, not keeled.* Helminthoglypta.)

E. dupetithoursi Dh., iv, 71.
oregonensis Lea.
E. sequoicola Coop., iv, 71.
E. traskii Newc., iv, 71.
franki Coop., err. typ.
v. proles Hemph.
v. cuyamacensis Hemph.
v. tularensis Hemph.
E. ellipsostoma Pilsbry.
E. carpenteri Newc., iv, 71.
indioensis Yates.
remondii Gabb, not Tryon.
E. coloradoensis Stearns, viii, 225.
E. magdalenensis Strns, viii, 226.
E. rowellii Newc., iv, 72.
lohrii Gabb.

* * *

E. exarata Pfr., iv, 73.
E. arrosa Gld., iv, 72.
æruginosa Gld.
f. obscura Pils.
f. holderiana Coop.
f. stiversiana Coop.
E. californiensis Lea, iv, 119.
vincta Val.
v. nickliniana Lea., iv, 73.
arboretorum Val.
f. anachoreta W. G. B.
E. californiensis Lea.
v. ramentosa Gld., iv, 73.
reticulata Pfr.
f. bridgesii Newc.
parkeri Tryon.
v. diabloensis Coop., iv, 74.
v. contracostæ Pils.
E. ayresiana Newc., iv, 70.
E. tudiculata Binn., iv, 74.
f. cypreophila Newc., iv, 75.

* * *

E. trypanomphala Pfr.

E. rémondi Tryon.
verrilli Anc. C. Ex., ii, 63.

(*Shell globose or depressed, rather cretaceous.* Micrarionta.)

E. gabbi Newc., iv, 77.
v. facta Newc., iv, 77.

E. ruficincta Newc., iv, 72.

* * *

E. intercisa W. G. B., iv, 74.
crebristriata Newc.
f. albida Hemph.
f. callojunctis Pils.
v. redimita W. G. B., iv, 74.
f. castanea Hemph.

E. kellettii Fbs., iv, 119.
f. multilineata Hemph.
f. castanea Hemph.

E. stearnsiana Gabb, iv, 119.
E. tryoni Newc., iii, 229.
E. veitchii Newc., iii, 228.
E. areolata Sowb., iii, 228.
canescens Ad. & Rv., iii, 214.
f. exanimata Coop.
E. levis Pfr., iii, 228.
E. pandoræ Fbs., iii, 228.
damascenus Gld.

Genus EULOTA Hartmann.

= *Eulota* Hartm. 1842, + *Thysanota*, *Plectotropis* and *Aegista* Alb. 1860, + *Armandia* Anc. 1883 and *Pseudiberus* Anc., + *Cathaica* Mlldff. 1884, + *Euhadra* Pils. 1890, + *Dorcasia*, *Hadra* and *Camæna* of some authors.

Shell usually umbilicated, dextral or sinistral, varying from globose to depressed or lens-shaped, thin or solid, unicolored or few banded; surface striated, often with spiral lines. Aperture lunate or angular, the outer and basal lips generally expanded, columellar lip dilated. Type *E. fruticum*, pl. 55, figs. 1, 2, 3, 4. (See also pl. 64, all figures except 7, 10–12.)

Animal with feebly tripartite sole, small right and left body-lobes on mantel, a pair of dorsal grooves, and very weakly indicated facial grooves or none; sides of foot granulated as in *Helix s. str.*, tail with an ill-defined central line or none. Right eye retractor passing between branches of genitalia (or in sinistral species the left one).

Jaw arcuate, with 3 to 12 ribs dentating the concave margin (pl. 65).

Radula normal, the mesocones about as long as basal-plates, side-cusps weakly developed or represented by a lateral continuation of main cutting-points; marginals with the inner cusp bipid (ento-*plus* meso-cone), ectocone simple or bifid (pl. 65).

Genitalia: penis extending into an epiphallus which sometimes has, sometimes has not, a flagellum. Dart sack containing a round or flat dart, and either borne on atrium or higher on vagina. *Mucus gland inserted on dart sack, or on an empty accessory sack communicating with dart sack*, and consisting of one or many *sacculated or glandular, long or oval branches, bound closely together and to the dart sack.* Spermatheca oval or globose, on rather a long duct, which lacks diverticulum.

Distribution, Central Europe (one species) to Japan, south to E. Indian Archipelago. Especially characteristic of Eastern Asia.

This genus differs widely from the European dart-bearing Helices in having the one (often many-branched) mucus gland *inserted on the dart sack* or on an accessory empty sack, and in the structure of the gland itself. It is more closely allied to the American genera *Epiphragmophora* and *Cepolis* in the structure of the mucus gland.

Eulota, as herein understood, comprises a great variety of shell-forms and a large number of species; including, indeed, a considerable majority of the East Asiatic Helices. As in all other large genera of Helices, the shell varies from globular to lens-shaped (see introduction to this volume); and the several stages of contour, each represented by a numerous progeny of species, have received names which some writers use in a subgeneric, some in a generic, sense. In my opinion, the former is the more philosophic view, as the shell characters fade from one group to another, offering no sharp line of demarkation throughout the genus, so far as I can see. As to the anatomy, my dissections (a part of which are shown on plates 65, 66) tell clearly that no grounds for a division of the group into two or more genera can be based thereon, unless the forms in which the penis has a flagellum be separated generically from those lacking this organ; and I do not think it likely that the examination of more material will add to the value of this feature. At all events, I can find no character of shell or soft parts correlated with it, and we are hardly justified in founding a genus on a single peculiarity, unless it be one of greater value than this. Like *Polygyra, Thersites* or *Helix s. str.*, the various anatomical divergencies, except as to the flagellum, are fully covered by intermediate forms; although, as a whole, the genus is characterized by well-marked peculiarities which would enable one to identify any of its members by an inspection of the genital system alone, without the assistance of shell characters.

The main anatomical divergencies may be tabulated as follows for the species now known anatomically:

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Species.	*Flagellum.*	*Dart sack.*	*Acces. sack.*	*Mucus gl. branches*
Eulota fruticum,	absent,	inserted high,	present,	2 to 4.
Eulotella similaris,	absent,	inserted low,	absent,	2 sub-dividing.
Eulotella fodiens,	absent,	inserted high,	present,	2 sub-dividing.
Eulotella duplocincta	absent,	inserted low,	present,	6 sub-dividing.
Acusta tourannensis,	absent,	inserted high,	?	sev'ral br'nches
Acusta ravida,	absent,	inserted high,	present,	sev'r'l coal'sc'nt
Cathaica pyrrhozona,	absent,	inserted low,	absent,	many br'nches.
Cathaica przewalskii,	?	inserted low,	?	2-branched.
Plectotropis vulv.	present,	inserted low,	absent,	2-branched.
Mastigeulota kiang.,	present,	inserted low,	present,	many br'nches.
Euhadra quæsita,	present,	inserted low,	present,	many.
Euhadra peliomph.	present,	inserted low,	present,	many.
Euhadra brandti,	present,	inserted low,	present,	many.

It will be noticed that *Plectotropis*, *Mastigeulota* and *Euhadra* possess a flagellum; the other sections lacking it, probably by degeneration, as this organ was, in all likelihood, present in the primitive Belogonous stock. Among the true Helices *Eremina* and *Euparypha* have also lost the flagellum, by a parallel process.

Section *Eulota* Hartmann, 1842.

Eulota Hartm., Erd- und Süsswasser-Gast. Schweiz, p. 179, type *H. fruticum*.—*Helicella* and *Fruticicola*, in part, of some authors.—*Bradybæna*, in part, Beck.—*Eulotella* Mousson (where?) of some authors, type *H. similaris* Fér.—*Acusta* Alb., Die Hel., 1860, p. 56, type *H. ravida* Bens.

Shell globose-conoid or globose-depressed, umbilicated, rather thin, the surface smoothish, generally with minute spiral striæ; color varying from sub-translucent white to light brown or yellowish, often with a supra-peripheral band (rarely several bands). Whorls 5–6, convex, the last hardly descending in front. Aperture round-lunate, toothless; peristome thickened within and expanded, dilated at columellar insertion. Type *E. fruticum*, pl. 55, figs. 1, 2, 3, 4. (See also pl. 55, fig. 19, *E. similaris*, and pl. 55, fig. 5, *E. duplocincta*).

Jaw arched, with 4–11 ribs denticulating the concave margin. (See pl. 65, fig. 4, *similaris*; pl. 65, fig. 5, *duplocincta*; fig. 2, *ravida*).

Radula of *E. fruticum* having the median cusp of middle teeth as long as basal-plate, side cusps subobsolete. Laterals with longer mesocones. Marginals with long bifid inner and on the outer ones

bifid outer-cusps (pl. 65, fig. 3, *similaris;* pl. 65, fig. 6, *duplocincta;* pl. 65, fig. 1, *ravida*).

Genitalia (pl. 66, fig. 18, *E. fruticum*): penis short, swollen, passing into a long epiphallus which receives vas deferens and retractor, but *lacks flagellum.* Dart sack globose, containing a round, conical dart (pl. 66, fig. 19), and communicating at base with an empty accessory sack which bears the mucus glands; these consist of 2–4 oval glands, closely bound together, and flattened on their adjacent sides, their ducts uniting into one canal which opens into the accessory sack. Duct of spermatheca long, inserted high on vagina. (See also pl. 66, fig. 20, *E. similaris;* figs. 21, 22, 23, *E. ravida;* fig. 24; *E. fodiens*).

Distribution, middle Europe to China and the East Indies.

Eulota is here used for a considerable number of Oriental snails having essentially the organization of the European *E. fruticum.* The penis lacks flagellum; the dart sack generally bears an accessory empty sack into which the many- or few-lobed mucus gland empties; and the dart is round in section or but little flattened, the shell being rather globose with conoidal, though low, spire. *Eulotella* Mouss., a sectional name used by von Martens for *E. similaris,* offers no distinctive characters of much value, except the obsolesence of the accessory sack on the dart sack. *Acusta* differs only in the thinner shell with simple lip, the mucus glands being either as in *E. similaris* (*tourannensis*) or being more closely bound together into one compact mass which envelops accessory sack and part of the dart sack (*E. ravida,* pl. 66, fig. 21; also fig. 22, reverse view of *d. s.* with mucus gland, and fig. 23, mucus gland turned back from *d. s.,* showing its insertion on accessory sack). The jaw of *Acusta* (pl. 65, fig. 2, *ravida*) has 8 strong close ribs. The radula (pl. 65, fig. 1, *ravida*) is not unlike other Eulotas, but the ectocones of marginal teeth are not split. Should the Oriental species be held sectionally distinct from the European *E. fruticum* on account of their more elongated and multi-sacculate mucus glands, they may be separated under the names *Acusta* and *Eulotella;* but v. Möllendorff, certainly a high authority on Asiatic snails, does not think two names required for them, uniting the three groups in *Eulota.*

One species of this group, *E. similaris,* has an unusually wide geographic range, extending from middle and southern China to Penang, Java, Celebes, etc., in which regions it is apparently indigenous. By the unconscious intervention of commerce it has be-

come colonized in Japan (Yokohama, Nagasaki, etc.); Bengal; Reunion, Mauritius, Rodriguez, Seychelles; Sandwich Is. (Kauai); Ascension Island; Brazil (Rio Janeiro, Bahia, etc.); Barbados, etc. It has been reported also from Cuba, Porto Rico and Jamaica, but is not now known to exist in those islands. It has been said to be found wherever the coffee tree has been carried, but this theory seems to be unsupported. In many cases I have found that it follows the cultivation of sugar-cane, also of Oriental origin. This seems to be the case in Barbados, Brazil, Kauai and the Seychelles, where *E. similaris* is commonly found on the borders of cane-fields.

E. arundinetorum Hde., iii, 207.
E. assimilaris Gredl.
E. assimilis Ad., iv, 48.
E. bactriana Hutt., iii, 212.
E. billeana Hde., iii, 209.
E. bitæniata Mlldff., viii, 221.
E. bocageana Cr., vi, 112.
E. brardiana Pfr., iii, 210.
E. burtinii Dh., iv, 48.
E. cavimargo Mart.
E. carinifera Semp., viii, 220.
E. cestus Bens., iii, 206.
E. cinctoinflata Monss., iv, 47.
E. coreanica A. & R., iii, 220.
E. cremata Hde., iii, 207.
E. despecta Gray, iii, 211.
E. dichroa Pfr., iii, 208.
E. dissimilis Semp., viii, 220.
E. duplocincta Mart., viii, 216.
E. elatior Mts., iii, 210.
E. extrusa T.-C., viii, 218.
E. fodiens Pfr., iii, 212.
E. fortunei Pfr., iii, 208.
  v. meridionalis Mlldff.
E. frilleyi C. & D., iv, 49.
E. fruticum Müll. iii, 200.
  terrestris Gmel.
  cinerea Poir.
  lucana Vallot.
  carduelis Reib.
  f. anderssoni Cless.
  f. mosellica Bgt.
  f. aubiniana Bgt.
  f. lemonia Bgt.
  f. dumorum Bgt.
  v. insularum West.
E. fuchsi Gredl.
E. graminum Hde., iii, 207.
E. hæsitans Hde.
E. hemisphærica Mlldff., viii, 223.
E. huberiana Hde., iv, 49.
E. impatiens Hde.
E. improvisa Hde., iii, 220.
E. jourdyi Morl., viii, 219.
E. laeta Gld., iv, 47.
E. latrunculorum Hde., iii, 221.
E. leprosa Hde.
E. leprosula Hde., iii, 220.
E. maackii Gerst., iii, 209.
  v. depressior Pfr.
  conrauxiana Hde., iii, 209.
E. mabillei Cr., iii, 216.
E. middendorffi Gerst., iv, 111.
E. mighelsiana Pfr., iii, 212.
E. miliaria Gredl.
E. mimicula Hde.
E. mola Hde.
E. nucleus Dh., iii, 207.
E. ? œnostoma Dh., viii, 223.
E. oncopila Hde., iii, 208.
E. oscitans Mts., iv, 47.
E. paricincta Mart., viii, 217.
  f. bisbicincta Mart.
  f. ambicincta Mart.
  f. incincta Mart.
  f. bilaticincta Mart.
E. peguensis Bens., vi, 113.
E. phæozona Mts., iii, 205.
E. phragmitium Hde., iv, 48.
E. physeta Anc., iv, 50.
E. pilidion Bens., vi, 114.
E. plicosa Mts. Nachr., '94, 135.

E. radicicola Bens., iii, 210.
E. ravida Bens., iv, 48.
helvacea Ph.
v. lineolata Mlldff., iv, 48.
E. ravidula Hde., iv, 49.
E. redfieldi Pfr., iv, 49.
E. rubens Mts., iii, 205.
f. concolor Mts.
f. finschiana Mts.
f. zeiliana Mts.
f. regeliana Mts.
E. ruppelli Dh., iii, 210.
E. scalpturita Bens., iii, 211.
E. schadenbergi Mlldff., viii, 223.
E. selskii Gerst., iv, 47.
E. semenovi Mart.
E. serotina Ad., vi, 106.
E. sieboldtiana Pfr., iv, 47.
E. similaris Fér., iii, 205.
translucens King.
woodiana Lea.
squalida Ziegl.
addita Fér.
epixantha Pfr.
f. stimpsoni Pfr., iii, 206.
genulabris Mart.
f. arcasiana C. & D., iii, 206.
f. borbonica Dh., iii, 206.
f. hongkongensis Dh., iii, 206.
f. obscura Dh., iii, 206.
E. suffodiens Bttg., viii, 219.
E. straminea Hde., iii, 207.
E. striatissima Dh., iii, 207.
E. tenimberica Mlldff., viii, 220.
E. tourannensis Soul., iii, 209.
globula Lea.
clusilis Val.
f. rhodostoma Mlldff.
E. transversalis Mss., iii, 210.
E. vagoina Gredl., iv, 257.
E. weyrichi Schr., iii, 209.
E. zoroaster Theob., iii, 211.

Section *Armandia* Ancey, 1883.

Armandia Anc., Il. Nat. Sicil., ii, p. 143, type *H. davidi* Dh. (March, 1883).

Shell rather small, quite *thin*, depressed-convex, the spire low-conoidal, *of few* (*about* 4) *rapidly widening whorls;* apex obtuse. Aperture very oblique; *peristome a trifle expanded, acute, much dilated at the columellar insertion*, partly closing the narrow umbilicus.

Anatomy unknown. Type *H. davidi* Desh. (See pl. 64, figs. 4, 5, 6, *E. calymma* Schm. & Bttg.).

Distribution: Thibet; interior China. The affinities of this group can only be guessed until the soft parts are made known.

E. davidi Dh., ii, 103.
sinica Mts.
E. moupiniana Dh., ii, 103.
E. calymma Schm. & Bttg.
E. plicatilis Dh., ii, 103.
E. sarelii Mts., iv, 49.
nora H. Ad.

Section *Cathaica* v. Möllendorff, 1884.

Cathaica Mlldff., Jahrb. D. M. Ges., 1884, p. 339, type *H. pyrrhozona* Ph.—Pilsbry, Man. Conch., viii, p. 204. Not *Cathaicus* Bates, 1870 (coleoptera).

Shell umbilicated, depressed, sculptured with striæ or riblets; whorls 5–7, slightly convex, the last usually somewhat angular at periphery. Aperture oblique; peristome thickened within, the upper margin unexpanded, outer and basal margins expanded, columella dilated. Type E. fasciola Dr. (=*pyrrhozona* Phil.,) pl. 55, figs. 6, 7.

Animal with the tail rounded above, no longitudinal groove. Sole indistinctly tripartite.

Jaw arcuate, with 3 to 7 weak ribs (pl. 65, fig. 8, *pyrrhozona;* pl. 65, fig. 15, *przewalskii*).

Radula with blunt mesocones on median and lateral teeth; marginals with the ectocone simple or bifid (pl. 65, fig. 7, *pyrrhozona;* pl. 65, figs. 16, 17, middle, and 1st, 2d, 10th, 14th, 18th, 23d, and 3 marginal teeth of *przewalskii*).

Genitalia: penis slender, ending in a long retractor and the terminal vas deferens. Dart sack large, opening into atrium, one dense cluster of about 10 club-shaped, glandular mucus glands inserted near its base. Spermatheca duct long (pl. 66, fig. 32, *E. pyrrhozona*).

Distribution, north and middle China and Central Asia.

E. brevispira H. Ad., viii, 208.
E. buddæ Hilb., viii, 208.
E. buvigneri Dh., viii, 212.
richthofeni Mts.
E. confucii Hilb., viii, 213.
E. constantiæ H. Ad., viii, 206.
"*constantinæ*," viii, 206.
E. desgodinsi Bgt., viii, 194.
E. giraudeliana Hde., viii, 210.
E. græseri Mouss., viii, 205.
E. gredleri Hilb., viii, 209.
stoliczkana Hilb., *olim.*
E. heudei Hilb.. viii, 210.
E. inopinata Dh., viii, 207.
E. kreitneri Hilb., viii, 211.
E. lutuosa Dh., viii, 212.
" lutosa " Try., iii, 208.
E. magnaciana Hde., viii, 207.
E. mongolica Mlldff., viii, 206.
E. orythia Mts., viii, 210.
E. pandynama Mab., viii, 194.
E. pekinensis Dh., viii, 205.
tchiliensis Mlldff.
f. conoidea Dh.
E. przewalskii Mts., viii, 209.
mencii Hilb.
E. pulveratricula Mts., viii, 211.
"*pulverella*" on pl.
loczyi Hilb.
E. pulveratrix Mts., viii, 211.
E. fasciola Drap. iii, 208.
pyrrhozona Ph., viii, 204.
faciola Dr., iii, 208.
E. schensiensis Hilb., viii, 211.
E. sempriniana Hde., viii, 207.
E. siningfuensis Hilb., viii, 211.
E. stoliczkana Nev., iii, 250.
E. subrugosa Dh., viii, 211.
v. kalganensis Mlldff.
E. thibetica Dh., viii, 208.
tibetica Mlldff.

Sinistral species.

E. christinæ H. Ad., viii, 213.
subchristinæ Anc.
v. subsimilis Dh.
? *carinifera* Ad.
E. filippina Hde., viii, 214.
E. dejeana Hde., viii, 215.
E. anceyi Mlldff., viii, 215.

Section *Pseudiberus* Ancey, 1887.

Pseudiberus Anc., Conchologist's Exchange, i, p. 76 (June, 1887), types *H. tectumsinense, zenonis*, etc.

Shell depressed-trochoidal, keeled, narrowly umbilicated, rudely striated; heavy, cretaceous and whitish; whorls about 5, the last deflexed. Aperture rhombic, oblique, the lip straight above, deeply arched, expanded and much thickened within, below. Type *E. tectumsinense* Mts., pl. 55, figs. 8, 9.

The anatomy of these snails is unknown, but they are probably a keeled and chalky manifestation of the *Cathaica* type. They inhabit interior China and central Asia.

E. tectumsinense Mts., iv, 59.
E. zenonis Gredl., iv, 59.
E. plectotropis Mts., iv, 58.
E. mataianensis Nev., iv, 59.

Section *Platypetasus* Pilsbry, 1894.

Shell lens-shaped, acutely keeled, thin, umbilicated; whorls 4½, the last descending in front. Surface smoothish. Aperture subhorizontal, oval; peristome expanded, reflexed below, the ends approaching and connected across the parietal wall. Type *E. innominata* Hde.

E. mariella H. Ad., viii, 196.
v. submariella Pils.
E. innominata Hde., viii, 197.
? *aquila* H. Ad.

Section *Thysanota* Albers, 1860.

Thysanota Alb., Die Hel., 1860, p. 63, type *H. guerini* Pfr.

Shell thin, corneous, narrowly umbilicated, trochiform; whorls numerous (7 to 8), narrow, with a fringe of hairs at the keeled periphery, extending up the suture. Base flattened; aperture angulate-lunar, the lip thin, simple, the columellar margin hardly expanded. Type *E. guerini* Pfr.

Distribution, Nilgiri and Anamullay Hills, southern India.

The anatomy is unknown. The group has usually been placed near *Trochomorpha*, but I am disposed to consider it near *Plectotropis*, partly on account of its hairy keel, partly because Blanford indicates *guerini* as a species lacking tail-pore. On the other hand, the simplicity of the lip favors the other view.

E. guerini Pfr., iii, 93.
crinigera Bens., iii, 94.
E. tabida Pfr., iii, 94.

Section *Plectotropis* Martens, 1860.

Plectotropis v. Mart., Die Hel., p. 121, type *H. elegantissima* Pfr.—*Thea* Alb., Die Hel., 1850, p. 118, not *Thea* Mulsant, 1846.

Shell depressed and carinated, widely umbilicated, dull and brown, with more or less shaggy cuticle and usually a peripheral fringe of hairs; whorls numerous (5 to 8), narrow and slowly increasing. Aperture small, angulate-lunar, oblique; lip narrowly expanded, reflexed below. Type *elegantissima*, pl. 64, figs. 18, 19. (See also pl. 64, figs. 16, 17, *E. mackensii*, typical form from Okinawa I., Liukiu group).

Jaw high-arched, with many (10–19) ribs, more or less denticulating the basal margin (Pl. 65, fig. 13, *E. vulvivaga*).

Radula (pl. 65, fig. 14, *E. vulvivaga*) having the middle tooth without side cusps, but with a lateral bulging, middle cusps about the length of basal-plate; laterals with a small ectocone. Marginals with the long inner cusp bifid, ectocone split into two. The dentition of *sumatrana* and *vulvivaga* is practically the same.

Genitalia (pl. 66, figs. 33, 34, *E. vulvivaga*): penis rather long, epiphallus short, strongly bent at the attachment of retractor, continued in a rather short, blunt flagellum. Dart sack large, containing a long, slightly curved dart, lens-shaped in section (fig. 34). Mucus gland inserted high on dart sack, divided into two glandular branches which are wide, flattened and rather incoherent, the dart sack and glands bound loosely to vagina. Duct of spermatheca very long and slender, without diverticulum, bound to oviduct.

Distribution: Japan, China and adjacent islands, south to Sumatra.

The anatomy of this group is known by Wiegmann's work on *sumatrana* and *rotatoria*, and by my own dissections. *E. rotatoria* has much the same form of genitalia as I have found in *E. vulvivaga*,

except for the dart sack and its appendages, which are absent in Wiegmann's figure. His specimen was a young one, and the organs *may* have been undeveloped; but I do not think this so likely as that the species is really no *Plectotropis*, but a *Ganesella*. Until adult examples are examined, I do not venture to transfer the species, especially since a vast majority of the forms of both groups are still anatomically unknown, and their systematic position consequently is only arbitrarily fixed by slight and obscure shell features.

E. mackensii Ad. & Rv., iv, 52.
v. mystagoga Mab., viii, 193.
v. vulvivaga Schm.& Bttg., viii, 193.
E. gerlachi Möll., iv, 52.
v. granulosostriata Mts.
v. abrupta Mts.
v. hunancola Gredl.
E. laciniosula Hde., iv, 53.
laciniosa Hde., not Lwe.
E. trichotropis Pfr., iv, 53.
v. laciniata Hde., iv, 53.
v. shanghaiensis Pfr., iv, 56.
E. elegantissima Pfr., iv, 52.
pretiosa Alb.
E. scepasma Pfr., iv, 58.
E. ciliosa Pfr., iv, 55.
E. lautsi Schm. & Bttg., viii, 193.
v. brachylasia S. & B., viii, 194.
E. squarrosa Gld., viii, 194.
E. granti Pfr.
E. ningpoensis Bttg., viii, 194.
E. esau Gredl., viii, 158.
E. patungana Gredl., viii, 158.
E. hupensis Gredl., iv, 54.
orthocheilis Hde.
E. (?) barbosella Hde., iv, 55.
E. subconella Mlldff., iv, 258.
E. loufouana Mlldff., iv, 258.
E. visayana Mlldff.
winteriana Semp.
E. winteriana Pfr., iv, 54.
E. intumescens Mts., iv, 54.
E. luzonica Mlldff., Nachr.,'94,114
E. sterilis Hde.
E. demolita Hde.
E. laciniata Hde.
calculus Hde., not Lwe.
E. sedentaria Hde.
E. parasitarum Hde.
E. parasitica Hde.
E. perplanata Nev., iv, 57.
E. akoutongensis Theob., iv, 57.
E. emensus Aust., P. Z. S. '88, 242.
E. ancylochila Cr., iv, 55.
E. mitanensis G.-A., viii, 195.
E. grumulus G.-A., viii, 195.
E. pudica G.-A., viii, 195.
E. emma Pfr., iv, 53.
E. huttoni Pfr., iv, 54.
orbicula Hutt., not Orb.
v. savadiensis Nev.
E. clarus Aust., P. Z. S., '88, 242.
E. catostoma Bens., iv, 62.
E. oldhami Bens. iv, 61.
E. tapeina Bens., iv, 53.
v. bhamoensis Nev., iv, 54.
E. (?) rotatoria Busch., iv, 54.
E. sumatrana Mts., iv, 56.
v. moussoniana Mts.
E. squamulosa Mss., iv, 56.

Section *Aegista* Albers, 1860.

Aegista Alb., Die Hel., 1860, p. 121, type *H. oculus* Pfr.

Shell depressed and broadly umbilicated, solid, striated; brown, unicolored or with a light peripheral band; spire low, composed of many narrow whorls, the last not keeled, descending in front. Aperture round lunar, oblique, the peristome toothless, narrowly expanded, somewhat thickened within, reflexed at base, ends converging. Type *E. oculus* Pfr., pl. 64, figs. 13, 14, 15.

External anatomy and genitalia unknown. Jaw arcuate, with about 6 wide, low, but separated ribs (pl. 65, fig. 10, *E. platyomphala*). Radula showing the same characters described for *Plectotropis*, but the outer marginals have the ectocone bifid (pl. 65, fig. 9, *E. platyomphala*).

Shells of this section differ from *Plectotropis* in lacking the peripheral keel and in the smoother surface, but there are some intermediate species. It has the same geographic range, extending northward to Kiusiu Island, Japan. The jaw of the only species examined has fewer ribs than in *Plectotropis*, but this is not likely to prove a constant difference.

(*Species of Japan, Liukiu Islands and Formosa.*)

E. kobensis Schm. & Bttg., viii, 196.
E. friedeliana Mart., iv, 61.
E. circulus Pfr., iv, 61.
E. oculus Pfr., iv, 59.
typinsana A. & R.
E. vermis Rve., iv, 60.
E. subchinensis Nev., iv, 62.

(*Species of China and India.*)

E. chinensis Phil., iv, 60.
E. pseudochinensis Möll., iv, 60.
chinensis Hde., not Phil.
E. platyomphala Möll., iv, 61.
E. serpestes Hde.
E. herpestes Hde., iv, 60.
E. furtiva Hde., iv, 60.
E. aubryana Hde., iv, 60.
E. accresens Hde., iv, 61.
E. hupeana Gredl., iv, 259.
E. phayrei Theob., iv, 55.
E. subcinctula Hde.
E. squamosella Hde.
E. mensalis Hde.
E. thoracica Hde., iii, 221.
E. secundaria Hde.
E. mellita Hde.
E. mellitula Hde.
E. permellita Hde.
E. rebellis Hde.
E. languescens Hde.
E. vicinella Hde.

E. gottschei Möll., iv, 62.
E. alphonsi Dh., iv, 61.
E. araneætela Hde., iv, 59.
E. accedens Hde.
v. initialis Hde., iv, 62.
E. radulella Hde., iv, 57.
E. turbo Pils.
turbinella Hde., not Morel.
E. talifouensis Hde.
taliensis Hde.
E. puberosula Hde., iv, 56.
pulverulenta H., not Lwe.

Section *Coccoglypta* Pilsbry, 1894.

Shell depressed conoidal with open umbilicus, solid, opaque and uniform brown; surface roughened by irregular oblique growth wrinkles and an uneven granulation; whorls about 6, convex, the last inconspicuously angled at periphery, rather tubular, slightly deflexed in front. Aperture small, round-lunate, oblique; lip simple above, expanded outwardly and below, somewhat dilated at columellar insertion. Type *H. dimidiata* Hde. (See pl. 64, figs. 20, 21, 22, 23, *E. pinchoniana* Hde.).

This Chinese group is unknown anatomically, but in my opinion its species cannot be included in either *Aegista*, *Plectotropis*, *Eulota* or *Cathaica*. The general figure of the shell reminds one of such large American Pyramidulas as *P. solitaria* or *cooperi;* but I have little doubt that *Coccoglypta* will prove a member of the *Eulota* group, conchologically distinguished by its granular shell with non-reflexed lip. The peripheral angulation is barely mentionable. It is probable that other species now placed in *Aegista* or *Ganesella* will prove to belong here.

E. dimidiata Hde.
E. pinchoniana Hde.

Section *Mastigeulota* Pilsbry, 1894.

Shell globose-depressed, rather solid, but like *Eulota* in form and sculpture. Jaw arcuate, with about 7 convex ribs. Radula much as in *Eulota*. Genital system (pl. 66, fig. 26, *E. kiangsinensis*) like *Eulota* in the dart sack and accessory sack, the dart long and slightly curved, a little flattened; mucus gland consisting of numerous sacculated branches bound together and to the *d. s.* (but shown torn free in figure), as in *Euhadra* and some *Eulotas*. Penis ending in a flagellum, and in *E. kiangsinensis* it is dilated above into a hollow, thin-walled bulb.

This section is founded upon *E. kiangsinensis*, which has the essential features of *Euhadra* rather than *Eulota*, the penis bearing

a flagellum. Probably some other Chinese species will prove to belong here, which are now placed in *Eulota*. The natural limits of these minor groups cannot be defined until more forms are known anatomically, although much can still be done by careful comparisons of large series of Oriental shells.

E. kiangsinensis Mts., viii, 216. Middle China.
? unizonalis H. Ad.
v. major Mlldff.
v. cerasina Gredler.

Section *Tricheulota* Pilsbry, 1894.

Chloritis SEMPER, Reisen p. 234, not of Beck.

Shell rather thin, umbilicated, depressed, all over hairy; aperture nearly vertical, lunate, the lip well expanded. Type *E. spinosissima* Semper.

Genitalia: Penis club-shaped, passing into a long epiphallus which ends in a flagellum. Dart sack large, the single long, club-shaped mucus gland inserted upon it (as in the section *Monadenia* of *Epiphragmophora*). Spermatheca with short duct, less than half the length of uterus.

Differs from *Mastigeulota* and *Euhadra* in the single club-shaped mucus gland, and the hairy shell. The presence of a flagellum separates this group from *Eulota*. The species are from Mindanao, Philippines. *Conf. Chloritis? brevidens*, etc.

E. sanziana H. & J., vi, 272.
lituus Rve, figs. 93*a*, *b*.
E. spinosissima Semp., vi, 273.
boxalli Sowb.

Section *Euhadra* Pilsbry, 1890.

Euhadra PILS., Man. Conch. (2) vi, p. 94, 95, 305.—*Hadra* and *Camæna* of authors.

Shell dextral or sinistral, rather large and thin, capacious, depressed, with low or conic spire and moderate or closed umbilicus; whorls about 6; surface striated and typically decussated by microscopic spiral lines; banded or streaked, rarely unicolored. Aperture lunate, oblique, the peristome expanded throughout, subreflexed at base. Type *E. peliomphala* Pfr., pl. 64, figs. 1, 2. (See also pl. 64, fig. 3, *amaliæ*, and fig. 9, *E. quæsita* var. *perryi* Jay).

Jaw wide, arched, with 8 to 14 wide, contiguous ribs, (pl. 65, fig. 12, *E. quæsita* var. *perryi*).

Radula having mesocones only on middle and inner lateral teeth; outer laterals with ectocone. Inner marginals with bifid oblique inner and simple outer cusp, the outer teeth with bifid ectocone (pl. 65, fig. 11, *E. quæsita* var. *perryi*).

Genital system (pl. 66, figs. 27, 28, 29, *E. quæsita* var. *perryi*) having the penis long; epiphallus long, bearing the retractor, flagellum rather short; dart sack enormous, containing a flattened, longitudinally costate dart, (figs. 27, 28); adnate on d. s. is an accessory sack, upon which a cluster of sacculated mucus glands is inserted, these glands being closely bound together and to the dart sack, as in other forms of *Eulota*, and with fibres connecting with uterus. Duct of the globose spermatheca long. (In fig. 29 the mucus glands are shown torn free from each other and from the dart sack by the removal of their investing membrane, as has been done with the other figures on plate 66).

Euhadra was instituted to include a group of rather large species of Japan and China, which had been placed in *Hadra* and *Camæna* by authors. It contains the largest and most conspicuously colored belogonous Helices of East Asia, excepting, of course, the Philippine Island Helicostylas. The bands of these forms are not homologous with those of European Helices, excepting possibly the supraperipheral one, which was probably present in very ancient Helices, and is retained in many and diverse groups.

The Japanese forms of *Euhadra* are so variable that after examining about a thousand specimens from many localities, I am disposed to consider some forms described by Kobelt and others merely varieties. The genitalia of *quæsita*, *peliomphala* and *brandtii* are very similar, but the first of these has more ribs on the jaw.

(*Group of Simodæ*).

E. simodæ Jay, vi, 95.
E. connivens Pfr., vi, 96.
v. phæogramma Anc.
E. herrmannseni Pfr., vi, 98.
koreana Pfr.

(*Group of Luhuana*).

E. luhuana Sowb., vi, 305.
luchuana Auct.
v. peliomphala Pfr., vi, 99.
japonica Dh., not Fér.
v. callizona Cr., vi, 105.
v. amaliæ Kob., vi, 105.
congener Sm.
v. congenita Sm., vi, 103.

E. luhuana.
v. eoa Cr., vi, 98.
v. sandai Kob.
v. subatra Pils.
v. subnimbosa Kob.
v. nimbosa Cr., vi, 101.
v. brandtii Kob., vi, 101.
v. nipponensis Kob.
v. hickonis Kob.
conica Pils., vi, 305.
E. herklotsi Mts., vi, 101.
E. senckenbergiana Kob., vi, 102.
E. miranda Ad., vi, 104.
E. lewisii Sm., vi, 106.
E. myomphala Mts., vi, 107.
daimio Ad.
E. quæsita Dh., vi, 108.
v. perryi Jay, vi, 108.
montium Mts.

(*Group of Swinhoei*).

E. swinhoei Pfr., vi, 115.
E. caspari Mlldff., vi, 115.
E. pantheia Mab., vi, 116.
E. granulifera Mlldff., vi, 306.
E. renaltiana Hde., vi, 307.
E. schmackeri Mlldff., vi, 307.
E. ammiralis Pfr., vi, 117.
E. cecillei Phil., vi, 109.
E. moreletiana Hde., vi, 110.
E. bairdi H. Ad., vi, 111.

(*Group of Succincta*).

E. succincta H. Ad., vi 118.
E. friesiana Mlldff., vi, 118.
E. stenozona Mlldff., vi, 118.
E. hæmatozona Hde., vi, 119.
E. submandarina Pils., vi, 122.
E. nux Mlldff., vi, 307.
E. cremata Hde.
E. seguiniana Hde.
E. delavayana Hde.
E. hemiclista Schm. & Bttg.
E. mercatoria Gray, vi, 121.
E. mellea Pfr., vi, 97.
E. purpurascens Pfr., viii, 297.
E. massiei Morl., viii, 223.
E. philippinensis Semp., vi, 123.

(*Group of Batanica*).

E. latilabris Mlldff., vi, 109.
E. yaeyamensis Pils.
E. formosensis Pfr., vi, 112.
E. batanica A. & R., vi, 111.
v. pancala S. & B., viii, 224.
sinistrorsa Möll., not Dh.
E. bacca Pfr., vi, 112.

Section *Mandarina* Pils., 1894.

Shell solid, compact, globose-conic; *axis solid*, imperforate.

E. mandarina Gray, vi, 124. Bonin Is.

Genus CHLORÆA Albers, 1850.

Chlorœa Alb., Die Hel., p. 113; v. Mart., edit., p. 169, type *H. sirena*.—*Gruppe der bunt-schaligen Chlorœen* Semper, Reisen, etc., p. 226.—Pilsbry, Manual vii, p. 93.

Shell *imperforate*, varying from depressed-globose to lens-shaped, generally solid; whorls 4–5, the last descending in front or not; lip decidedly reflexed, at least below. *Entire surface* showing under the lens *excessively fine close spiral lines; lacking hydrophanous markings.* Type *C. sirena*, pl. 55, figs. 15, 16, 17.

Foot, jaw and radula (pl. 54, fig. 3, *benguetensis*) as in *Helicostyla.*

Genital system (pl. 54, figs. 2, 4, *benguetensis*); penis as in *Helicostyla*, without flagellum (*benguetensis, hügeli*), or having a very short one (*sirena*). Dart sack oval, containing a long lance-shaped dart (pl. 54, fig. 4, *benguetensis*). Mucus gland single, lengthened, composed of irregularly grouped large follicles. Duct of spermatheca moderately long.

Distribution: Luzon, Marinduque, Mindoro, Cebu, Tablas, Mindanao, Sibuyan, Luban and Guimaras, Philippines; *living upon trees.*

This group is more allied to *Eulota* than to *Helicostyla* in the soft anatomy and dart; but the species have assumed the arboreal habits and bright coloring of the latter genus.

Group of C. fibula.

C. fibula Brod., vii, 94.
C. hanleyi Pfr., vii, 95.
v. hugeli Pfr.
bifasciata Lea.
C. benguetensis Semp., vii, 96.
C. geotrochus Mlldff., vii, 97.
C. antonii Semp., vii, 97.
C. amoena Pfr., vii, 98.
C. sirena Beck, vii, 98.
v. cebuana Mlldff.
v. guimarasensis Pils.
C. pelewana Mouss., vii, 99.
C. gmeliniana Pfr., vii, 100.
C. hennigiana Mlldff., Nachr., '93, 173.

Group of C. dryope.

C. dryope Brod., vii, 100.
prasina Koch.
C. coerulea Mlldff., vii, 101.
C. cristatella Mlldff., Nachr., '93, 173.

Group of C. paradoxa.

C. paradoxa Pfr., vii, 102.
f. immaculata Pils.
C. undina Pfr., vii, 102.
C. constricta Pfr., vii, 103.
restricta Pfr.
stenopsis Moq.

Group of C. thersites.

C. thersites Brod., vii, 104. C. malleata Q. & M.. Nachr., '93, 174.

Genus HELICOSTYLA Férussac.

Helicostyla Fer., Tabl. Syst., p. 46, in part.—Beck, Index Moll., p. 36, 1837, in part.—Albers, Die Hel., 1850, p. 104.—H. & A. Adams, Gen. Rec. Moll., ii, p. 191.—Martens, Die Hel., p. 175, type *H. mirabilis* Fér.—*Cochostyla* Fer., Tab. Syst., p. 47, 1819.—Semper, Reisen in Arch. Phil., Land Moll., p. 164.—Pilsbry, Man. Conch., vii, p. 92. Includes the groups Chlorœa, Corasia, Crystallopsis, Axina, Pfeifferia, Calocochlia, Helicostyla, Orustia, Cochlodryas, Orthostylus, Helicobulinus, Ptychostylus, Phengus, Eudoxus, Hypselostyla, Canistrum, Prochilus, Chrysallis, etc.

For anatomy see Semper, Reisen im Archip. Phil. and Pfeffer, Jahrb. Dm. Ges., 1878, p. 195.

Shell varying from depressed, helicoid, to elevated and bulimoid, imperforate, with *solid columella* (except in *Crystallopsis* and *Chrysallis*); surface smooth or roughened, usually covered with a thin, transparent cuticle, often *porous in places when it becomes white and opaque, producing the "hydrophanous" pattern* which ornaments most species, and which disappears upon wetting the shell. Aperture toothless, but sometimes having a columellar twist or truncation; the lip reflexed (but simple in *Pfeifferia*). Type *H. mirabilis* Fér. (see pl. 53, fig. 1–11).

Foot without pedal margination; a small left body-lappet often developed; kidney elongated. (Pl. 54, fig. 10, *H. festiva;* pl. 54, fig. 5, *H. monticula*).

Jaw ribbed (pl. 54, fig. 6, *H. butleri*).

Radula with bluntly pointed or truncated mesocones on middle and lateral teeth, *without trace of side cusps.* Marginal teeth having the entocone indicated by a split in the broad inner cusp, a small simple ectocone being developed. (See pl. 54, fig. 11, *H. aegle;* pl. 54, fig. 12, *H. pulcherrima.*

Genital system: Penis moderately long, passing into an epiphallus which bears the retractor; flagellum wanting. *Dart sack short and globose,* seated on atrium or low on vagina, *bearing an accessory sack into which the mucus gland opens. Mucus gland globular or*

oval, with a very short duct, its thick wall composed of radially arranged follicles (pl. 54, fig. 7, longitudinal section of mucus gland of *H. butleri*). Dart short, straight, and round in section. Spermatheca oval, on a long, branchless duct (pl. 54, fig. 8, *H. butleri;* pl. 54, fig. 9, *H. pithogaster* with its dart).

Distribution: Philippine Is., with a few species in the Moluccas, in New Guinea and the Solomon Islands. Habits mainly arboreal.

As in most large genera of Helices, the shells of *Helicostyla* exhibit a very wide range of forms, some being heavy, dark, depressed and keeled, others globose and thin with brilliant green or variegated coloring, while still other species are of an elongated Bulimus-like contour. Peculiar air-permeated cream-white epidermal bands and patches are characteristic of many but by no means all species, and in most the columella is solid.

The jaw is of the usual ribbed type. The teeth are like those of some Papuinas, but in the lack of side cusps on middle and lateral teeth they resemble *Eulota*. The genital system is highly characteristic in the globose form of the mucus gland, which as in other Belogona euadenia is inserted on the dart sack. In the subgenus *Canistrum* (*q. v.*) a variation in this is found. Our knowledge of the anatomy is due to Semper, whose work upon the group leaves little to be desired except the examination of those subgenera which he did not dissect, *Prochilus*, *Chrysallis*, *Papustyla*, *Crystallopsis*, etc., and the further investigation of *Canistrum* and allied forms.

It is clear that *Helicostyla* is very near in anatomy to the primitive Belogonous stock, retaining early characters in the simple unsplit and nearly sessile mucus gland and needle-like, bladeless dart. Its differentiation in shell characters is attributable to long isolation and the assumption of arboreal habits. The Philippine Chloræas were probably derived from a later incursion or an early split, which has not spread through the entire Philippine group. The *Camœna*, *Euhadra* and *Eulota* forms are perhaps to be regarded as a more recent addition to the fauna.

The subgenus *Helicostyla* was proposed by Férussac for a heterogeneous assemblage of shells including certain *Zonitidæ*, two *Sagdas* and a *Gastrodonta*, the two species of *Stylodonta*, *Cepolis* (*Coryda*) *alauda* and *H. mirabilis* and *coniformis*. The *Sagda* and *Gastrodonta* were later removed from the group by Férussac himself (Tabl. Syst., p. 67); and Beck in 1837 eliminated from it most

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other incongruous elements, leaving only *H. alauda* and its varieties and *H. mirabilis* (galactites), and adding *smaragdus* and *roissyana*. Albers in 1850 restricted *Helicostyla* to Philippine Island snails of the *mirabilis* type, erecting for the West Indian *H. alauda* the new group *Coryda*. H. & A. Adams make *Helicostyla* a genus to include *Calocochlea, Corasia, Axina, Chloræa*, etc., and place the elongated forms in genus *Cochlostyla* under Buliminæ.

Cochlostyla was instituted by Férussac on the page of the *Tableaux* after *Helicostyla*, and contained species belonging to the groups Helicostyla, Helicobulinus, Orthostylus, Cylindrus, Caryodes, Orphnus, Dryptus, Orthalicus, etc. The name dropped out of nomenclature entirely until 1847, when Gray names it under *Orthostylus*, giving *metaformis* as its type. Later, the Adams brothers revived it as a genus for elongated Philippine Island forms; and in 1860 von Martens uses it in much the same sense. In enlarging the genus to include both depressed and elongated species, Semper unfortunately retains the name *Cochlostyla* for the entire series, a course which has been followed by subsequent writers.

In conclusion it is evident that for this genus we must use the name *Helicostyla*, which not only has prior position in Férussac's work, but was restricted in 1837 by Beck and properly limited by Albers; while *Cochlostyla* was later in the original publication, and remained a heterogeneous mass of Bulimi and Helicostylæ until Gray in 1847 selected *metaformis* as its type.

Subdivisions.

With the exception of *Canistrum*, the sections of this genus are practically identical in anatomy; and rest upon such shell characters as contour, thickness and sculpture. The presence of intermediate species renders their arrangement somewhat artificial.

Depressed or globose, thin, without hydrophanous cuticle.
  Globose, white, lip simple and sharp, *Pfeifferia*.
  Lip expanded or reflexed, *Corasia, Crystallopsis*.

Globose, few whorled, with hydrophanous bands, *Leytia*.

Globose or depressed, solid, lip expanded or reflexed.
  No hydrophanous cuticle, lip narrow; highly colored, *Chromatosphæra*.
  Hydrophanous cuticle present, lip wider, *Calocochlea*.
  Dark, depressed and much roughened forms, *Trachystyla*.
  Dark and smoothish forms, *Anixa*.

Globose or elevated-oval, moderate sized or small.
Heavy and thick, without hydrophanous cuticle, *Pachysphæra.*
Oblong, not especially heavy, color in browns, *Helicostyla.*
Oblong, suture white-bordered, color vivid, *Cochlodryas.*
Subconic, with hydrophanous cuticle, *Orustia.*

Elevated and conical or turbinate, mostly large.
Whorls numerous, equal; columella very short with a strong fold, *Columplica.*
Whorls more rapidly increasing; columella longer, *Orthostylus, Helicobulinus.*

Elongated and bulimoid.
Imperforate, *Hypselostyla, Papustyla, Eudoxus, Phengus, Canistrum.*
Perforated, *Prochilus, Chrysallis.*

Section *Corasia* Albers, 1850.

Corasia Alb., Die Hel., p. 111; second edit., p. 170, type *H. virgo.*

Shell imperforate, depressed-globose or flattened and keeled, *thin*, subdiaphanous; whorls 3½–5, rapidly widening, the last hardly descending in front; lip slightly expanded or narrowly reflexed. *No hydrophanous markings.* Type *H. virgo* Brod., pl. 55, fig. 12.

Anatomy as in other Helicostylas. The shell differs from Calocochlia in being thinner without "hydrophanous" decoration. Distribution, Philippine Is., except Palawan. Arboreal.

Group of H. reginæ.

H. reginæ Brod., vii, 116.
smaragdina Grat.
v. almæ Mlldff., vii, 117.
v. elizabethæ Semp., vii, 117.
H. papyracea Brod., vii, 117.
? acutangula Burrow.
H. psittacina Dh., vii, 118.

Group of H. virgo.

H. virgo Brod., vii, 119.
H. dealbata Brod., vii, 119.
broderipi Rve.
H. patricia Pfr., vi, 196.
H. casta Pfr., vii, 120.
H. ægrota Rve., vii, 124.
H. samboanga H. & J., vii, 124.
zamboangæ Mts.
v. intaminata Gld.
H. magtanensis Semp., vii, 125.

H. puella Brod., vii, 120.
v. lais Pfr., vii, 121.
v. subpuella Pils., vii, 121.
H. irosinensis Hid., vii, 121.
H. æruginosa Pfr., vii, 122.
H. filaris Val., vii, 122.
v. nympha Pfr.
v. tenuis Mlldff., vii, 126.
v. expansilabris Mlldff., vii, 126.
H. eydouxi Hid., vii, 123.
valenciennesii Pfr., not Eyd.
H. broderipi Pfr., vii, 123.
H. intorta Sowb., vii, 125.
v. crassa Mlldff., vii, 125.
v. siquijorica Mlldff., vii, 125.
H. limansauensis S., vii, 126.
H. sphærion Sowb., vii, 154.
f. intincta Shutt., vii, 154.
v. nana Semp., vii, 155.
v. crassilabris Mlldff.
v. meridionalis Mlldff.
H. saranganica Mlldff., viii, 245.
H. globulosa Mlldff., Nachr., '95, 96.
H. loheri Mlldff., Nachr., '94, 115.

Section *Crystallopsis* Ancey, 1887.

Crystallopsis Anc., Conchol. Exch., ii, p. 23, types *H. hunteri* and *allasteri*.

Shell thin, depressed globose or depressed and keeled, translucent whitish or banded, the axis perforated, at least in the typical forms. Surface spirally striated; lip expanded. Type *H. hunteri* Cox. See pl. 55, figs. 10, 11, *H. tenimberica* Mlldff.

Jaw (of *H. conformis*) semicircular, perfectly smooth. Radula as in *Helicostyla*.

Genital system (Frontispiece, fig. 4, *H. conformis*) as in *Helicostyla*.

The shell is similar in general features to *Corasia*, but the jaw of *H. conformis* has been shown by Tapparone-Canefri to be smooth (Ann. Mus. Civ. Genov., xix, pl. 8, f. 1, 8, 15). Distribution, Solomon Is. to Moluccas.

Group of H. lactiflua.

H. hunteri Cox, vii, 105.
H. allasteri Cox, vii, 106.
allisteri Pils., typ. err.
H. aggei Heimb., viii, 244.
H. subvitrea Pfr., vii, 107.
H. cymodoce Cr., vii, 107.
H. lactiflua Pfr., vii, 108.
isabellensis Souv.
H. purchasi Pfr., vii, 108.
H. rossiteri Ang., vii, 109.
H. wisemani Braz., vii, 109.
H. aphrodite Pfr., vii, 109.
H. anadyomene Ad. & Ang., vii, 110.
H. psyche Ang., vii, 110.
H. balcombei Cox, vii, 111.
H. woodfordi Sowb., viii, 243.
H. tricolor Pfr., vii, 111.
v. picta Sm., vii, 112.
v. transenna Pils., vii, 112.
H. tenimberica Mlldff., viii, 244.

Group of H. extensa.

H. conformis Fér., vii, 113.
H. leucophthalma Pfr., vii, 113.
H. extensa Müll., vii, 114.
H. cœlaxis Pils., vii, 114.
H. najas Pfr., vii, 115.
H. physalis Pfr., vii, 115.
H. obliquata Dh., vii, 116.

Section *Pfeifferia* Gray, 1853.

Pfeifferia Gray, P. Z. S., 1853, p. 110. type *H. micans* Pfr.

Shell *globose*, imperforate, the slender axis solid; *thin, brittle, uniform white and glossy;* whorls 4, the last not descending in front. Aperture lunar; *lip thin, acute and fragile;* columella slightly thickened, vertical, deeply inserted in the base. Animal as in Helicostyla generally, except that the mantle is reflexed over the acute lip.

H. micans Pfr., vii, 128. Northern Luzon.

Section *Leytia* Pilsbry, 1892.

Leytia Pils., Man. Conch., vii, p. 129 (Jan. 30, 1892).

Shell imperforate, globose, thin; whorls few (4), the last angulated at periphery; surface spirally striate, having hydrophanous cream white bands. Aperture very large; lip simple, a little expanded below; columella simple, thin, vertical, deeply inserted. Anatomy unknown.

H. fragilis Sowb., vii, 129. Island of Leyte, Philippines.
leytensis Pfr.

Section *Chromatosphæra* Pilsbry, 1892.

Chromatosphæra Pils., Man. Conch., vii, p. 169 (Jan. 30, 1892).

Shell imperforate, depressed globose, solid and opaque, *richly colored but lacking hydrophanous markings;* surface *lacking spiral sculpture;* last whorl *scarcely descending* in front; *lip blunt,* very narrowly reflexed throughout; columella subvertical, *deeply inserted,* the umbilical area covered by a concave white callus. Anatomy typical. Type *H. aurata* Sowb.

Distribution, Northern Luzon.

H. aurata Sowb., vii, 170.
H. erubescens Semp., vii, 170.
v. luteocincta Semp., vii, 171.
H. lividocincta Semp., vii, 171.
H. pudibunda Semp., vii, 171.

Section *Calocochlea* Hartmann, 1842.

Calocochlea Hartm., Erd- und Süsswasser Gasterop. Schw., p. 163, type *pulcherrima* Sowb.—*Callicochlias* Agassiz, 1847, and of authors.

Shell imperforate, solid, subglobose, generally with varied pattern and hydrophanous cuticle. Soft anatomy typical. Type *H. pulcherrima* Sowb., pl. 55, fig. 13.

Group of H. cromyodes.

H. cromyodes Pfr., vii, 130.
valenciennii Eyd.
H. denticulata Jay, vii, 131.
H. albaiensis Sowb., vii, 132.
H. tukanensis Pfr., vii, 132.
H. obtusa Pfr., vii, 132.
H. amicta Rve., vii, 133.
H. decora A. & R., vii, 133.
H. ? semirufa Alb., viii, 245.

Group of H. pulcherrima.

H. pulcherrima Sowb., vii, 133.
H. festiva Don., vii, 134.
luzonica Sowb.
annæ O. Semp.
H. dubiosa Pfr., vii, 135.
speciosa Jay.
batanica Rve.
volubilis Rve.
H. lalloensis Pfr., vii, 136.
H. angusta Alb., vii, 136.
H. princeps Rve, vii, 137.
H. erythrospira Mlldff., vii, 137.
H. generalis Pfr., vii, 137.
H. chrysochila Sowb., vii, 138.
chrysocheila Sowb.

Group of H. polillensis.

H. polillensis Pfr., vii, 138.
f. portei Pfr.
f. ajax Pfr.
f. hector Pfr.
f. peraffinis Pils., vii, 139.
H. andromache Pfr., vii, 139.
H. codonensis Hid., vii, 140.
H. decipiens Sowb., vii, 140.

Group of H. zonifera.

H. zonifera Sowb., vii, 141.
samarensis var. Semp.
v. circe Pfr., vii, 142.
purpurascens Mts.
v. globosa Mlldff.
v. paraleuca Pils., vii, 142.
H. coronadoi Hid., vii, 142.
v. pulchra Pils., vii, 143.
H. cailliaudi Dh., vii, 144.
ferruginea Lea.
H. microspira Pfr., vii, 145.
H. hemisphærion Pfr., vii, 145.
H. samarensis Semp., vii, 146.
H. coccomelas Sowb., vii, 146.
speciosa Pfr., not Jay.
H. ponderosa Pfr., vii, 147.

H. norrisii Sowb., vii, 143.
H. damahoyi Pfr., vii, 143.
H. luengoi Hid., viii, 245.
H. hidalgoi Mlldff., viii, 246.
samarensis Hid., not Semp.

H. chrysæme Q.& M. Nachr.,'93, 175.
H. streptostoma Mlldff. Nachr.,'93 176.
H. semperi Mlldff. Nachr., '93, 175.
H. trisculpta Mlldff. Nachr., '95, 97.

Group of H. mindanaensis.

H. mindanaensis Sby., vii, 148.
mindana Rve.
mindorana Hartm.
H. harfordii Sby., vii, 148.

Group of H. melanochila.

H. pan Brod., vii, 149.
H. depressa Semp., vii, 149.
lignaria Pfr., preoc.
v. perdepressa Pils.
H. melanochila Val., vii, 150.
brunnea Sowb.
H. chlorochroa Sowb., vii, 150.
H. matruelis Sowb., vii, 151.
H. difficilis Pfr., vii, 151.
H. mainitensis Hid., vii, 152.
H. lignicolor Mlldff., vii, 153.
H. roissyana Fér., vii, 151.
solida Pfr., vii, 153.
rossiana Gray.
f. lutea Pils.
f. subatra Pils.
H. infuscata Alb., vii, 152.
H. xanthobasis Pils., vii, 155.
H. dimera Jonas, vii, 156.
H. crossei Hid., vii, 156.
H. retusa Pfr., vii, 156.
H. libata Rve., vii, 157.

Section *Anixa* Pilsbry, 1894.

Axina Alb., Die Hel., p. 113, 1850; v. Mart., 2d edit., p. 71, type *H. zebuensis*. Not *Axina* Kirby, 1817 (coleoptera).

Shell imperforate, *solid, dark colored;* varying from depressed and keeled to globose turbinate; more or less covered with hydrophanous cuticle; smoothish, lacking spiral sculpture; lip narrowly or broadly reflexed. Soft anatomy as in *Helicostyla* generally. Type *H. zebuensis* Brod. (See pl. 55, fig. 14, *H. moreletiana* Pfr.).

These are ground snails, mainly confined to Luzon, Cebu and Siquijor.

H. garibaldiana D. & S.,vii, 159.
H. siquijorensis Brod., vii, 159.
v. pallens Mlldff.
H. kobelti Mlldff., vii, 160.
H. zebuensis Brod., vii, 161.
v. striatissima Pils., vii, 162.

H. schadenbergi Mlldff., vii, 160.
H. pfeifferi Semp., vii, 162.
cumingi Pfr., preoc.
H. phloiodes Pfr., vii, 163.
H. carbonaria Sowb., vii, 163.
f. rubens Mlldff.
H. magistra Pfr., vii, 164.
v. gloynei Sowb., vii, 165.
ecarinata Mlldff.
H. moreleti Pfr., vii, 165.
H. montfortiana Pfr., vii, 165.
H. bruguieriana Pfr., vii, 166.
H. beloni Jouss., Le Nat., '94, 186-

Section *Trachystyla* Pilsbry, 1892.

Trachystyla Pils., Man. Conch., vii, 166.

Shell solid, depressed, *dark colored, with a dull ashen hydrophanous cuticle;* spire low; *whorls few and rapidly widening;* columella oblique, straight; surface dull and *wrinkle malleated.* Type *H. cryptica.*

Species of this group live on the ground under leaves, etc.; and while the shell differs widely from arboreal Helicostylas, the soft anatomy is the same. The few species inhabit eastern Mindanao, Samar, Bohol, Leyte and Luzon.

H. cryptica Brod., vii, 167.
v. latitans Brod., vii, 167.
? dionacea Dh.
v. depressa Mlldff., 1893.
v. cretata Brod., vii, 168.
v. minor Mlldff.
v. panayensis Semp., vii, 168.
v. tumida Mlldff.
v. subglobosa Mlldff.
v. nigricans Mlldff.
v. cineracea Semp., vii, 168.
H. dataensis Semp., vii, 169.

Section *Helicostyla* Fér., (restricted).

After the removal of *Cochlodryas, Pachysphæra,* etc., a considerable number of oblong shells grouping around H. mirabilis, metaformis and fenestrata remain to represent this section, the type of which is *H. mirabilis* Fér., pl. 53, fig. 7.

Group of H. mirabilis.

H. mirabilis Fér., vii, 181.
formosa Wood.
galactites Lam.
persimilis Dh.
f. trichroa Pils., vii, 182.
v. fulgens Sowb., vii, 182.
H. tephrodes Pfr., vii, 183.
H. ? plurizonata A. & R., vii, 183.

Group of H. collodes.

H. collodes Sowb., vii, 184.
H. indusiata Pfr., vii, 184.
H. thomsoni Pfr., vii, 185.
H. suprabadia Semp., viii, 246.

Group of H. metaformis.

H. metaformis Fér., vii, 186.
ovularis Mke.
H. rustica Mouss., vii, 187.
H. hydrophana Sowb., vii, 187.
H. butleri Pfr., vii, 188.
H. languida Pfr., vii, 189.
H. unica Pfr., vii, 189.
H. fuliginata Mts., vii, 188.
fumigata Semp.
v. nigrolabiata Mlldff.
H. lacera Pfr., vii, 189.
H. rehbeini Pfr., vii, 190.
H. roebeleni Mlldff., Nachr., '95, 98.

Group of H. fenestrata.

H. montana Semp., vii, 191.
H. fenestrata Sowb., vii, 192.
H. curta Sowb., vii, 192.
v. dilatata Pfr., vii, 193.

Section *Cochlodryas* Martens, 1860.

Cochlodryas Mts., in Die Hel., p. 176, type *H. polychroa*. *Pœcilus* Alb., mss.

Elevated, vividly colored species lacking hydrophanous cuticle, and with a distinct subsutural band which is generally white. Type *H. polychroa*, (=*viridostriata*) pl. 53, fig. 10.

H. florida Sowb., vii, 177.
helicoides Pfr.
H. viridostriata Lea, vii, 178.
? smaragdus Beck.
polychroa Sowb.
H. orbitula Sowb., vii, 179.
chlorogrammica Val.
H. tenera Sowb., vii, 179.
H. ignobilis Sowb., vii, 180.
H. boettgeriana Mlldff., vii, 181.

Section *Orustia* Mörch, 1852.

Orustia Morch, Cat. Yoldi, p. 15, in part, first species *H. monticula*.

Shell imperforate, turbinate-globose, not spirally striated, banded, *with hydrophanous cuticle;* lip thin, narrowly reflexed; columella, vertical, deeply entering. Anatomy typical. Type *H. monticula*, pl. 54, fig. 5 (see also pl. 53, fig. 1, *H. versicolor*).

Distribution, Luzon.

H. monticula Sowb., vii, 176.
H. pulchella Mlldff., Nachr. ['93, 176.
H. versicolor Mlldff., viii, 246.
H. strigata Mlldff. Nachr. '95, [97.

Section *Pachysphæra* Pilsbry, 1894.

Pachysphæra Pils., Man. Conch. vii, p. 172 (Jan. 30, 1892).

Shell *small, globular or globose-elevated, solid,* brightly colored; *lacking hydrophanous cuticle* and spiral striæ. Type *H. sphærica* Sowb.

Confined to north-western Luzon.

H. sphærica Sowb., vii, 172.
H. balteata Sowb., vii, 173.
H. annulata Sowb., vii, 174.
H. iloconensis Sowb., vii, 175.
v. heterotæniata Pils.
v. xanthotæniata Pils.
v. intensior Pils.

Section *Columplica* Hartmann, 1842.

Ptychostylus Mlldff., Nachrichtsbl. D. M. Ges. 1888, p. 74.—Not *Ptychostylis* Gabb, a group of *Trochidæ*. Not *Ptychostylus* Sandberger, Land- u. Süsswasser-Conch. der Vorwelt, p. 58 (*Melaniidæ*) *Stylodonta* (in part) of authors.—*Columplica* (in part) Hartmann, Gasterop. Schweiz, p. 187, 188 (*H. uniplicata* and *H. dolium*=*cepoides*).—*Hypoptychus* Pilsbry, Proc. Acad. Nat. Sci. Phila., 1892 p. 395, footnote.

Shell globose-turbinate, formed of *many closely coiled whorls,* the surface having hydrophanous cuticle; aperture narrowly lunar; columella spirally twisted, *having a strong tooth-like fold* at the base.

Animal externally like *Cochlostyla,* internal anatomy unknown.

A peculiar and isolated type resembling *Stylodonta unidentata* of the Seychelles Islands. It was first classed in *Cochlostyla* by Semper. The name *Ptychostylus* being preoccupied, the writer proposed to substitute *Hypoptychus;* but it seems best to revert to Hartmann's *Columplica.*

H. cepoides Lea, vii, 194. *Island of Luban.*
dolium Hartm.

Section *Helicobulinus* Broderip, 1840.

Helicobulinus Brod., P. Z. S. 1840, p. 123, type *H. sarcinosa.*—*Helicobulimus* Mollendorff, Landschn. Cebu, p. 241.—*Chromocochlea* Hartmann, Gast. Schweiz, p. 137, 1844, type *C. turbinoides.*—*Chromatocochlias* Agassiz.

Shell capacious, *turbinate*-globose, solid, variegated with green or brown, covered with a variously patterned hydrophanous cuticle.

Columella more or less folded. Type *H. sarcinosa*. (See pl. 53, fig. 2, *H. turbinoides*).

This section, while closely allied to *Orthostylus*, presents affinities with so many groups that it must be regarded as an intermediate or synthetic type.

H. grandis Pfr., vii, 195.
colossea Pfr.
carolus Dh.
H. sarcinosa Fér., vii, 195.
v. turgens Dh., vii, 196.
H. turbinoides Brod., vii, 196.
H. cinerascens Pfr., vii, 197.
v. turbo Pfr., vii, 197.
H. bembicodes Pfr., vii, 198.

Section *Orthostylus* Beck, 1837.

Orthostylus Beck (in part), Index, p. 49.—Martens in Alb. Die Hel. p. 177.—v. Mlldff., Landschn. Cebu, p. 242.—*Pithohelix* Swains., Malacol., p. 166.—*Pythohelix* Swains., *l. c.*, p. 332.

The shell is generally large, solid, ovate-conic, covered with a variously patterned hydrophanous cuticle. Aperture oblique, ovate; lip reflexed; columella nearly vertical, more or less obviously folded below. Anatomy typical. Type *H. pithogaster*, pl. 53, fig. 3.

The present section is allied to *Helicobulinus*, which consists of more inflated shells, and to *Hypselostyla*, containing more elongated forms. The limits of *Orthostylus* are not easy to determine, as there are species almost or entirely intermediate between this group and *Helicostyla*, as well as forms connecting with *Hypselostyla*. With the exception of Mindoro and Mindanao, it occurs on all the Philippine group.

H. bicolorata Lea, vii, 199.
alberti Brod.
v. onyx Brod., vii, 199.
H. imperator Pfr., vii, 199.
H. pithogastra Fér., vii, 200.
f. philippinensis Pfr., vii, 201.
? *strigata* Mlldff.
f. bipartita Pils. vii, 201.
H. villari Hid., vii, 201.
f. ventricosa Mlldff.
H. daphnis Brod., vii, 201.
H. cunctator Rv., vii, 202.
H. faunus Brod., vii, 203.
H. ticaonica Brod., vii, 203.
B. subglobosus Lea.
f. lutea Pils.
H. lignaria Pfr., vii, 204.
H. gilva Brod., vii, 205.
H. woodiana Lea, vii, 206.
reevii Brod.
reevei Pfr.
H. portei Pfr., vii, 207.
portii Pfr. *olim.*
H. rufogastra Less, vii, 207.
B. monozonus Pfr.
H. macrostoma Pfr., vii, 208.

H. vidali Hid., vii, 208.
H. juglans Pfr., vii, 208.
f. olivacea Mlldff.
f. roseolimbata Mlldff.
H. nux Semp., viii, 5.
H. marinduquensis Hid., vii, 209.
woodianus Pfr. not Lea.
H. amaliæ Mlldff., viii, 245.

Elongated Orthostylus.

H. mus Brod., viii, 6.
H. leucophæa Sowb., viii, 6.
H. glaucophthalma Pfr., viii, 7.
H. senckendorffiana Pfr., viii, 7.
H. solida Pfr., viii, 8.
H. pictor Brod., viii, 8.
B. labropurpureus Grat.
H. solivaga Rve., viii, 9.
H. leopardus Pfr., viii, 9.
H. aplomorpha Jonas, viii, 11.
H. fulgetrum Brod., viii, 12.
? *Bul. antipodarum* Gray.
H. ventricosa Chem., viii, 10.
nobilis Rve.
f. guimarasensis Rve.
f. decorata Fér.
f. frater Fér.
H. satyrus Brod., viii, 13.
v. palawanensis Pfr.
v. cyanocephala Pils.
v. cinerosa Pfr., viii, 15.
v. graellsi Hid., viii, 14.
v. librosa Pfr., viii, 12.
H. cæsar Pfr., viii, 15.
H. fischeri Hid., viii, 29.

Section *Hypselostyla* Martens, 1868.

Hypselostyla Mts., in Pfr., Monogr. Hel. Viv. vi, p. 7, 16, for *nympha* and *dactylus*.

Shell *imperforate, narrow and elongated*, usually rather thin and somewhat keeled at periphery; peristome narrowly expanded. (See pl. 53, fig. 6, *H. connectens* Mlldff.).

Distribution, central Philippines.

H. cincinna Sowb., viii, 16.
labiozonalis Grat.
pastorella Val.
v. gracilis Lea.
v. virens Pfr.
v. spretus Rv.
v. romblonensis Pfr.
H. groulti Jousse. Le Nat. '94, 136.
H. succincta Rve., viii, 17.
H. cincinniformis Sby., viii, 18.
H. carneola Grat., viii, 19.
H. subcarinata Pfr., viii, 19.
f. möllendorffi Hid.
H. evanescens Brod., viii, 20.
H. eburnea Rve., viii, 20.
H. nimbosa Brod., viii, 21.
B. pfeifferianus Rve.
H. elegans Semp., viii, 21.
siquijorensis Pfr., preoc.
H. carinata Lea, viii, 22.
dactylus Brod.
v. nympha Pfr., viii, 23.
H. turris Semp., viii, 23.
H. diana Brod., viii, 24.
f. calista Brod., viii, 24.

H. calypso Brod., viii, 25.
H. camelopardalis Brod., viii, 25.
v. boholensis Brod., viii, 26.
v. connectens Mlldff.
H. hainesi Pfr., viii, 26.
H. accedens Mlldff. Nachr. ['95, 99.

Group of H. concinna.

H. concinna Sowb., viii, 27.
v. flammula Semp., viii, 27.
H. acuminata Sowb., viii, 28.
H. incompta Sowb., viii, 28.
H. pyramidalis Sowb., viii, 28.
nebulosus Pfr., viii, 29.

Section *Papustyla* Pilsbry, 1893.

Papustyla Pils., Man. Conch. viii, p. 243, July 1, 1893.

Shell rimate or imperforate, elongated, with slender spire; peristome expanded. Distribution, New Guinea, New Britain group.

H. translucida Q. & G., viii, 29.
H. papuensis Hedl., vii, 190.
H. hindei Cox, viii, 30.
H. heimburgi Branc., viii, 30.

Section *Eudoxus* Albers, 1850.

Eudoxus Alb., Die Hel., p. 137; edit. v. Mart., p. 179. type *B. effusus* Pfr.

Shell ovate or ovate-conic, imperforate, smooth, shining, very light colored, generally thin and destitute of hydrophanous cuticle. Columella rather narrow, its face flattened. Type *H. effusa* Pfr., pl. 53, fig. 11.

Distribution, Marinduque, Luzon, Romblon, Burias.

H. effusa Pfr., viii, 31.
f. fasciata Pils.
H. halichlora Semp., viii, 32.
H. leai Pfr. viii, 32.
H. jonasi Pfr., viii, 32.
albersi Pfr.
buschi Pfr.
perdita Rve.
breviculus Rve.
? *leai* Pfr.
H. simplex Jonas, viii, 33.
H. virginea Lea, viii, 36.
bullula Brod.
albinus Grat.
chloroleuca Mart.
bustoi Hid.
H. hololeuca Pfr., viii, 37.
H. smaragdina Rve., viii, 37.
v. nigrescens Semp.
v. lutea Semp.
v. striata Semp.
v. zonifera Semp.

H. quadrasi Hid., viii, 34.
cossmanniana Cr.
H. modesta Sowb., viii, 35.
B. hindsi Pfr.
B. verecundus Rve.
H. belcheri Pfr., viii, 35.
B. hindsi Rve.
H. lacerata Semp., viii, 36.
paradoxa Semp., olim.
H. straminea Semp., viii, 39.
H. cumingi Pfr., viii, 39.
H. ægle Brod., viii, 40.
v. barandæ Hid., viii, 40.
H. oviformis Semp., viii, 40.
H. uber Pfr., viii, 41.
H. phæostyla Pfr., viii, 41.

Section *Phengus* Albers, 1850.

Phengus ALB., Die Hel., p. 137, for *B. opalinus* and *B. evanescens*.—v. MART., Die Hel., 1860, p. 180, type *H. opalina*.

Shell thin, pale green, distinctly trochoidal, and with no hydrophanous cuticle. Type *H. opalina* Sowb., pl. 53, fig. 5.

These shells have the texture and color of *Eudoxus*, but differ in their trochiform contour. Anatomically, *Phengus* forms a transition to *Canistrum*, the dart sack being small and without a dart, and the globular mucus gland is much reduced in size.

H. opalina Sowb., viii, 42.
H. dumonti Pfr., viii, 42.

Section *Canistrum* Mörch, 1852.

Canistrum MORCH, Catal. Yoldi, p. 31.—PILS., Manual viii, p. 43.

Shell ovate-conic or oblong, imperforate and solid; banded; with or without hydrophanous cuticle; surface microscopically spirally striated; whorls narrow; lip well expanded; columella vertical. Type *H. ovoidea* Brug., pl. 53, fig. 4.

Genital system as in *Helicostyla* except that the dart sack and mucus glands are absent (pl. 54, fig. 1, *H. stabilis*).

That the simplicity of the generative system is probably the result of degeneration of the dart apparatus is shown by the approach to this condition in *Phengus*. The anatomy of *Canistrum* is otherwise as in *Helicostyla*. It is very desirable that more species be examined anatomically, for intermediate stages of development. When *Prochilus* and *Chrysallis* are dissected, their anatomy may throw light upon the condition of *Canistrum*.

H. ovoidea Brug., viii, 43.
luzonicus Sowb.
costerii Eyd.
euryzonus Pfr.

H. balanoidea Jonas, viii, 44.
H. stabilis Sowb., viii, 45.
H. brevicula Pfr., viii, 45.
H. velata Brod., viii, 12.
v. elongata Mlldff.

Section *Prochilus* Albers, 1860.

Prochilus Alb., Die Hel., p. 179, type *Bul. virgatus.*

Shell narrowly *perforated,* of an *elongated* ovate-pyramidal long-spired form, *smooth and shining. Aperture less than half the length of shell; peristome very broadly reflexed.* Soft anatomy unknown. Type *H. virgata* Jay, pl. 53, fig. 9.

Strikingly handsome elongated shells, confined to Mindoro and the Cuyos Is.

H. calobapta Jonas, viii, 46.
cuyoensis Rve.
H. cuyoensis Pfr., viii, 47.
H. fictilis Brod., viii, 47.
v. larvata Brod., viii, 48.
H. nigrocincta Semp., viii, 50.
pan Pfr., not Brod.
H. mercurius Pfr., viii, 50.
H. calamianica Q. & M., Nachr., '95, 99.
H. virgata Jay, viii, 48.
labrella Grat.
v. porracea Jay.
v. sylvanoides Semp.
v. pulchrior Pils.
H. dryas Brod., viii, 49.
paradoxus Pfr.
H. partuloides Brod., viii, 50.

Section *Chrysallis* Albers, 1850.

Chrysallis Alb., Die Hel., p. 140 (in part).—v. Mart., Die Hel., 1860, p. 179, type *B. chrysalidiformis.*

Shell *perforated, elongated* ovate-conic, solid, opaque and *not smooth;* aperture ovate, less than half the shell's length; lip broadly expanded; columellar margin dilated and reflexed; hydrophanous cuticle usually present. Soft anatomy unknown. Type *H. chrysalidiformis* Sowb., pl. 53, fig. 8.

Evidently allied to *Prochilus.* Inhabits Mindoro only.

H. chrysalidiformis Sby., viii, 51.
v. ustulata Jay.
v. antonii Semp.
H. electrica Rve., viii, 53.
lichenifer Mörch.
f. cailliaudi Petit.
H. mindoroensis Brod., viii, 52.
wagneri Grat.
aspersus (part) Grat.
melanogaster Mörch.

Genus LEUCOCHROA Beck, 1837.

Leucochroa B., Index Moll., p. 16, in part (keeled *Xerophila*, etc., with *L. cariosa, cariosula, candidissima*).—Morch, Cat. Yoldi, p. 5, 1852, Mal. Bl. iv, p. 109.—Kobelt, Nachrbl. 1875, p. 37 ; Iconogr. Land- u. Süsswasser-Moll. n. ser., iii, p. 29.—*Calcarina* Moq. Tand., Mém. Ac. Toulouse, iv, 1848, and Moll. Fr. ii, p. 69 (not *Calcarina* d'Orb.).

Shell *solid and strong, chalky, white,* subglobose or depressed, and keeled, at least when young ; axis hollow, often closed in the adult ; surface smoothish or pitted ; embryonal shell consisting of about 1½ smooth whorls ; last whorl generally deflexed in front. Aperture small, half-round, oblique ; *lip blunt and simple* (in section *Sphincterochila* much contracted) the columellar insertion dilated, ends remote. Type *L. candidissima*, pl. 56, fig. 13 (see also pl. 56, figs. 14, 15, *L. cariosa*).

Animal with rather small foot ; upper surface coarsely granular, with a pair of dorsal grooves ; facial grooves indistinct ; no foot margin, caudal pore or longitudinal line on the tail. *Sole distinctly tripartite,* the middle area wide, side areas narrow, meeting at tail. Mantle-edge rather thick, with very rudimentary right and left body lappets. *Right eye retractor passing to the left of the genitalia,* not between its branches.

Jaw (pl. 36, fig. 14, *L. candidissima*) solid, arcuate, with a low median projection, *its surface entirely smooth.*

Radula of the type usual in *Helicidæ.* Middle tooth with square basal plate shorter than the large mesocone ; side cusps absent. Lateral teeth similar but asymmetrical. Marginals with shorter basal plate, the inner cusp (ento- *plus* mesocone) bifid, ectocone small, simple or bifid (pl. 36, fig. 13, *L. candidissima.* Pl. 36, fig. 16, *L. boissieri*).

Genitalia (pl. 36, fig. 15, *L. bœtica ;* pl. 57, figs. 52, 53, *L. candidissima*) : penis very short, narrowing into a much twisted epiphallus, upon which below, the retractor muscle is inserted ; terminating in a flagellum and vas deferens. Vagina stout, bearing a flattened spiral, or an elongated gland upon a slender short duct ; spermatheca duct long, its lower half convoluted upon the base of the uterus, to which it is closely bound ; bearing a short stouter diverticulum, the end of which is sunken in the uterus ; upper portion of the spermatheca duct slender, straight, bound to the uterus

and terminating in a globular spermatheca (pl. 57, fig. 53, duct dissected away from uterus and straightened). *Ovo-testis very large and compact, completely occupying the earlier* 1½ *whorls.*

Distribution, circum-Mediterranean region. The area occupied by this genus is the same as that of *Otala plus* Levantina, being coincident with the region where the olive grows. As in Macularia one species (*vermiculata*) extends throughout the range of the group, so in Leucochroa, *L. candidissima* has an equally wide distribution, occurring in Palestine (v. *hierochuntina*), northern Africa and westward in Europe to southern Spain. The other species are all local. Many of them show not only much individual variation, but also numerous well-marked local varieties; and the complete tale of these has not yet been told.

This genus is distinguished by its cretaceous solid shell, conspicuously tripartite sole, smooth jaw and the teeth and genitalia of *Helix*, except that the dart sack is wholly absent, the mucous appendages reduced to one straight or coiled sacculated gland, and the ovotestis not enveloped in the digestive gland.

The group has had a varied literary existence, Moquin-Tandon, in 1848, removing it from the Helices to Zonites on account of the smooth jaw; and later systematists, Martens, Westerlund, Kobelt and others have adopted this view in their several works. Binney, upon examining the teeth of *L. boissieri*, declared it a Helix, and has been followed by Fischer and Tryon. It only remains to say that there can be no doubt that *Leucochroa* belongs to the belogonous Helicidæ, and has not the slightest affinity to the Zonitidæ. It is more nearly allied, in the peculiar position of the eye retractor, to *Helicella* than to other genera, but differing in the loss through degeneration of the dart and its sack, and in the smooth jaw—both of these being purely secondary modifications. I have retained the genus in *Belogona euadenia* on account of the sacculated mucus gland of *candidissima;* but a careful dissection of some species with elongated mucus gland, like *bœtica*, should be made, with histological examination of the mucus gland and the minute spur at its middle (see pl. 36, fig. 15), to ascertain more certainly the place of the genus. Probably the spur mentioned is a remnant of the dart sack. The anatomy is known by Schmidt's figures representing *candidissima, bœtica, cariosa* and *cariosula* (= *hispanica*), and the writer's dissection of *candidissima.*

Two sections are recognized, *Leucochroa*, with the lip simple, type *candidissima*, and *Sphincterochila* Anc., with the mouth angular, much contracted by an inward thickening of the lip, and a bifid nodule in the posterior angle.

Section *Leucochroa* Beck.

L. candidissima Drap., iii, 10.
f. rimosa C. & J.
v. hierochuntina Boiss.
v. sardoa Malz., viii, 55.
sarda Kob., on pl.
L. isserica Kob., viii, 57.
L. bætica Rossm., iii, 11.
v. alexandrina Fag., iii, 11.
v. tunetana Let. & Bgt.
L. otthiana Fbs., iii, 11.
v. thayaca Bgt., iii, 11.
v. titanodolena Pch., iii, 11.
v. jeannotiana Terv., iii, 11.
Zonites piestius Bgt.
v. chionodiscus Pfr., iii, 11.
L. spiranomala Bgt., viii, 55.
speiranomala Bgt., in Pech.
L. argia Bgt., iii, 12.
L. adanensis Naeg., viii, 57.
L. prophetarum Bgt., iii, 12.
L. cariosula Mich., iii, 13.
L. fimbriata Bgt., iii, 12.
v. myopa West.
v. illicita Mss.
v. varicosula West.
L. debeauxi Kob., viii, 55.
L. mayrani Gass., iii, 13.
v. subcariosula Bgt., iii, 13.
kobeltiana Deb.
L. octinella Bgt., viii, 55.
vetula West.
L. hispanica West., viii, 56.
L. saharica Deb., viii, 56.
L. cariosa Oliv., iii, 13.
v. amphicyrta Bgt.
v. nazarensis Mouss.
v. crassocarina Mouss.
L. ultima Mouss., iii, 14.
L. pressa Mouss., iii, 14.
L. accola Mouss., iii, 14.

Section *Sphincterochila* Ancey.

Mima Westerlund, Fauna Palaäret. Binnenconch., i, p. 88, 1886 (for *boissieri* and *filia*). Not *Mima* Meigen, Diptera, 1820.—*Sphincterochila* Ancey, Conch. Exch., Aug., 1887, p. 23 (for *filia* and *boissieri*).

Shell solid white and chalky like *Leucochroa;* but the aperture is contracted by a building inward of the lip on its outer margin and at the sutural angle. Jaw and teeth as in *Leucochroa*. Type *L. boissieri*, pl. 56, figs. 11, 12.

Distribution, Palestine and northern Arabia.

L. boissieri Charp., iii, 14.
v. zonata Bgt.
L. filia Mouss., iii, 15.

Belogona Siphonadenia.

Dart-bearing Helices in which the mucus glands are tubes of equal diameter throughout, inserted directly upon the vagina, never upon the dart sack.

This definition, while it perfectly distinguishes the group under consideration from the Euadenia (p. 175), in which the mucus apparatus consists of glandular lobes, flat or globular, and with few exceptions inserted on the dart sack, will not cover all forms referred to *Siphonadenia*. The diagnosis-defying process of retrogressive evolution or degeneration has produced forms in which the dart apparatus and mucus glands have dwindled to a mere vestige, or been entirely lost; reverting to the condition found in the *Epiphallogona*, which as I have elsewhere attempted to show, were the stock whence *Belogona* arose. In these cases recourse must be had to such other organs as have not shared the degenerative process; to less divergent species, and to embryology for clues to the true history of doubtful forms. We cannot too strongly insist upon the recognition of that great difference between a *primitive structure* and similar structure produced by a reverse process from a more complicated organ. To lose sight of this would be to lose the best message these studies can bring us, and reduce systematic zoology to a mere index.

Fortunately, we have in the recent fauna, a considerable number of species showing clearly the various stages of degeneration which have resulted in those simplified forms of the genera *Helicella* and *Hygromia* which will be found noticed in the account of those groups. The evidence indicates that such forms as *Ciliella, Metafruticicola, Cochlicella*, etc. are recent degenerate groups, quite independently produced from at least four normal Belogonous types. It is noteworthy that the penis, jaw, radula and shell show no retrogressive features in these forms, but retain the characters normal for the genera they are believed to have descended from. The penis is not (as von Ihering states) of the *Patula* type (*Haplogona*), but is distinctly of the form normal in *Belogona* and *Epiphallogona*.

All recent Helices of Europe (except the Pyramidulas) belong to this division of the Belogona, and the same is probably true of the Tertiary fossil forms. Just as anatomical data have enabled us to eliminate the foreign group *Triodopsis* from this fauna, so more philosophical study must cause us to see in the supposed *Corasia, Chloritis, Obba, Pella, Charopa, Mesodon, Coryda*, etc. of the tertiary,

merely the ancestors of groups now living in Europe, and lateral branches of those phyla. The presence of snails belonging not only to modern *genera*, but to modern *subgeneric* or *sectional* groups, as low as the lower Miocene, indicates that for the roots of even these weakly characterized divisions, we must look still earlier; and the large spaces of Eocene time can scarcely be held sufficient for the differentiation of the genera now occupying the European tract. The absence of *Belogona Siphonadenia* from all regions except those now occupied by that group is negative evidence tending toward the view that the group developed its special peculiarities in that quarter of the world; and while this sort of evidence is always inconclusive, it has some weight in the total absence of facts making against it. A provisional hypothesis might be outlined, holding that the primitive Belogona (with the genital structure like *Helicostyla*) spread westward before or at the beginning of Eocene time, and in the Eur-African tract the stock became modified by the removal of the mucus glands from the dart sack, and their change into the tubular form, into the siphonadenious type; subsequently splitting into a considerable number of genera. Those genera which have spread again from this center are mainly minute forms capable of living in cold regions, such as *Vallonia* and *Acanthinula;* but the presence of *Helicodonta* and *Metodontia* in China, and of the East Asian genus *Eulota* in Europe, indicates a more southern connection also. These exchanges between the faunas of the east and west extremes of the Palæarctic continent are remarkably few, however; and we are compelled to believe that since the incursion which brought *Belogona* and many other Oriental types to Europe, the climatic or other conditions prevailing in Central Asia and Siberia have been unfavorable to the spread of land mollusks.

Of course there is no reason to believe that Helices of the Epiphallogonous type did not also reach Europe with or before the Belogona; and they may have survived there during Eocene and even Miocene times; in fact the genera *Dentellocaracolus*, *Fridolinia*, etc., may represent such survivors. But to state that this is the case, or that those genera belong to the Epiphallogona (i. e. are related to *Caracolus, Obba, Chloritis*, etc.) is merely to state one's pleasingly sensational flights of fancy as scientific truth. The evidence showing the presence of Ephiphallogona in Europe at any time, rests now upon the finding of certain rather heavy, rudely sculptured forms; but they are neither heavier nor more coarsely wrinkled than some Hemi-

cyclas, and may as readily have belonged to Belogona as to Epiphallogona, for anything now known; and while we should not at the present stage of malacology deny the presence in European Eocene and Miocene of genera allied to *Obba*, *Caracolus* (=*Pleurodonte*), etc., neither should palæontologists lightly affirm that "*Geotrochus*," *Obba*, *Chloritis*, etc., exist in European Tertiary, on the strength of mere resemblances of contour and sculpture—characters of no systematic value, and now abandoned by all helicologists in studying recent Helices.

Synopsis of recent genera.

1. Dart-sack 1; mucus glands 2 or in 2 clusters; spermatheca on a very long duct, usually with diverticulum; shell usually conspicuously banded.
   - *a.* Jaw with strong, convex vertical ribs; dentition normal.
     - *b.* Dart four-bladed; diverticulum free when present; shell typically five-banded, *Helix.*
     - *bb.* Dart two-bladed; diverticulum always present, united by a wide membrane to uterus; shell none to three banded, *Helicigona.*
   - *aa.* Jaw with converging flattened ribs; dentition normal, *Leptaxis.*
   - *aaa.* Jaw smooth; teeth all unicuspid and strap-shaped, *Allognathus.*
2. Dart sack 2, 1 or 0, the dart bladeless or two-bladed; mucus glands 0, 1, or several, rarely more than 2-branched; spermatheca duct short, with no diverticulum; shell with many or no bands.
   - *a.* Right eye-retractor passing between branches of genitalia, shell unicolored or 1-banded, rather corneous in texture.
     - *b.* Shell with well-reflexed and thickened lip, often toothed, *Helicodonta.*
     - *bb.* Shell with simple or expanded lip, texture corneous, aperture lunate.
       - *c.* Depressed-globose or depressed, not laminate, size moderate or small, *Hygromia.*
       - *cc.* Conoidal, with costate or lamellar riblets; minute, *Acanthinula.*
     - *bbb.* Aperture round, oblique, toothless; shell minute, depressed, few-whorled, *Vallonia.*

aa. Right eye-retractor passing to left of genitalia; shell more or less chalky; lip simple or expanded, *Helicella.*
? *Geomitra.*

This order of groups is reversed in the following pages.

Genus GEOMITRA Swainson, 1840.

= Geomitra Swains., + *Plebecula, Helicomela, Lemniscia, Hispidella, Spirorbula, Irus, Actinella, Rimula, Callina, Caseolus, Hystricella, Discula, Tectula, Placentula, Coronaria* and *Craspedaria* of Lowe, 1852–1854, + *Ochthephila* Beck, 1837, not Fallén, 1823, + *Heterostoma* Hartm., 1841 to '44, + *Turricula* Wollaston, 1878, not of H. & A. Adams, 1856.

Shell generally solid, rather cretaceous, unicolored or from one to three banded: varying from globular or pyramidal to lens-shaped or planorboid, the umbilicus open or closed. Aperture half-round or circular; lip more or less expanded, at least at the columella, usually thickened within, but having no lip-rib as in *Helicella* columella dilated or reflexed. Type *G. tiarella* W. & B. (See pl. 68, figs. 1–19).

Jaw low, slightly arcuate, with 15 broad, flat, crowded ribs in *tiarella*, about 8 broad, separated ribs in *lurida*. In *abjecta* there is a blunt median projection but *no ribs.*

Radula (pl. 67, fig. 18, *G. abjecta* Lwe.; pl. 70, fig. 40, *G. lurida* Lwe.) having *well-developed side-cusps* on middle teeth, the middle cusp about as long as the basal-plate. Lateral teeth bicuspid. Marginals with the inner cusp long, oblique, and feebly bifid, outer cusp bifid or even trifid.

Distribution: Madeira group of islands. Only the most unsatisfactory evidence exists to give ground for believing this genus to occur outside of the Madeira group, except as occasional immigrants, unless the occurrence of *G. paupercula* Lowe in the Azores and Canaries be owing to natural causes. Those indigenous species of the Canaries referred to *Hispidella, Discula, Ochthephila*, etc., may better be left in *Hygromia, Jacosta* and other groups, until they may be shown to actually have some characters of the Madeira forms. The Canary Island Helix fauna is far more closely allied to that of northern Africa than to that of Madeira.

It would obviously be quite idle to discuss the origin or genesis of this genus until its anatomy is made known. We are quite safe in

believing it an ancient inhabitant of the Madeira group, and its peculiarities have probably been developed upon that soil, for neither in the fossil series of Europe or the recent fauna of Eur-Africa or the other Atlantic islands are there known forms which may be referred to the Madeira genus. It is therefore much more restricted that the *Leptaxis* group. In this connection *conf.* Watson, The Journal of Conchology, vii, p. 1, 1892.

A large number of subgenera or sections have been founded for the Madeira Helices, which is not surprising when we consider the astonishing amount of modification of the numerous minor groups, altogether unparalled in any other tract of like extent in the world. Most of the following sectional groups have already been associated by Martens, Pfeiffer and others; but *Plebecula*, *Helicomela* and *Hispidella* are now added to the group for the first time.

The name *Ochthephila* being preoccupied, I have been obliged to substitute Swainson's term *Geomitra*. This has priority over *Heterostoma* Hartmann, as well as over the entire series of names proposed by Lowe.

Subgenus Plebecula Lowe, 1852.

Plebecula Lwe., Ann. Mag. Nat. Hist. (2), ix, p. 114, Feb., 1852, for *giramica, vulgata, canicalensis* Lwe.; P. Z. S., 1854, p. 172, type *H. vulgata* Lwe.—*Helicomela* Lwe., P. Z. S., 1854, p. 172, type *H. punctulata* Sowb.

Shell *globose-depressed* with conic spire, *or subglobular*, umbilicate or imperforate, solid, above rather rudely striated, granose or hirsute; unicolored, or 3-banded above on a brown ground, the base paler and uniform. Whorls 5–6, *separated by deep sutures*. Aperture but little oblique, *subcircular; lip hardly expanded*, sharp or thickened within; columella reflexed. Type *G. nitidiuscula* Sowb. (See pl. 43, fig. 26, *G. punctulata* Sowb.).

(Shell subglobular, imperforate; *Helicomela*).

G. punctulata Sowb., iv, 187.
v. avellana Lwe., iv, 187.
G. bowdichiana Fér., iv, 187.
vargasiana Pfr.

(Shell depressed-globose with conic spire, umbilicate; *Plebecula*).

G. nitidiuscula Sowb., iv, 188.
vulgata Lwe.
v. giramica Lwe., iv, 188.
anaglyptica Rv.
v. deserticola Woll.
v. pulchra Paiva.
G. nitidiuscula.
v. saxipotens Woll.
v. canicalensis Lwe., iv, 188.
G. lurida Lwe., iv, 188.
nitidiuscula Woll., not Sow.
v. hartungi Alb., iv, 189.

Subgenus LEMNISCIA Lowe, 1854.

Lemniscia LWE., P. Z. S., 1854, p. 170, type *H. michaudii* Dh.

Shell barely *perforate, nowhere granular, globose-conoid* or globose-depressed, with numerous (6½ to 8) slowly widening whorls, those of the spire striated; last whorl but little descending, the base smooth. Aperture half-round, lip blunt, thickened within, expanded toward the columella, *its ends remote, parietal wall nude.* Type *G. michaudii* Dh., pl. 68, figs. 14, 15.

G. michaudii Dh., iv, 21.
bicolor Lwe.
G. calva Lwe., iv, 41.
G. galeata Paiva, iv, 41.

Subgenus HISPIDELLA Lowe, 1852.

Hispidella LWE., Ann. Mag. N. H. (2), ix, Feb., 1852, p. 115, for *armitageana, revelata, sericea;* P. Z. S., 1854, p. 178, type, *H. hispida* L.

Shell *thin*, fragile, *brown*, not chalky; perforate, convex-depressed; surface bearing flattened cuticular scale-like processes, simulating the hairs of *Trichia.* Whorls less than 5, the last angular, slightly deflexed in front. Aperture half-round, slightly lunate, the peristome slightly expanded, reflexed at columella, ends remote. Type *G. armitageana* Lwe.

Has a superficial resemblance to the Fruticicoloid Continental forms, but the sculpture is like that of Lowe's section *Irus*, and I am disposed to consider the group as a member of the present genus. Lowe was clearly in error in naming as the type of his group a species which he had not mentioned in his original publication of the name. *H. horripila*, a doubtful member of the group, is from the Azores.

G. armitageana Lwe., iii, 223.
G. horripila M. & D., iii, 222.

Subgenus SPIRORBULA Lowe, 1852.

Spirorbula LWE., Ann. Mag. N. H., Feb., 1862, p. 114 (proposed for *H. latens* and *obtecta*); P. Z. S., 1854, p. 175, type *H. obtecta*

Lwe.—*Irus* Lwe., Ann. Mag., Feb., 1862, p. 114 (*laciniosa, squalida, depauperata*); P. Z. S., p. 174, type *H. depauperata* Lwe. Not *Irus* Oken, Naturgeschichte für Schulen, p. 647 (1821).

Shell perforated, globose-depressed, with conoidal or flattened spire, the whorls about 5, rounded, sutures deep; surface smoothish or coarsely wrinkled, sometimes bearing recurved cuticular scales. Aperture slightly oblique, round or oval, the parietal lip continuous and adnate. Type *G. obtecta*, pl. 68, fig. 13.

As the name *Irus* is preoccupied, its species may be merged in *Spirorbula*, which offers no very marked difference.

G. obtecta Lwe., iv, 35.
G. latens Lwe., iv, 35.
G. squalida Lwe., iv, 35.
G. depauperata Lwe., iv, 36.
G. latinea Paiva, iv, 36.
G. laciniosa Lwe., iv, 36.

Subgenus Actinella Lowe, 1852.

Actinella Lwe., Ann. Mag. N. H. (2), ix, Feb., 1852, p. 118, proposed for *stellaris lentiginosa, arcta;* P. Z. S., 1854, p. 180, type *H. lentiginosa* Lwe.—*Rimula* Lowe, *t. c.*, p. 118, for *obserata* and *fausta;* P. Z. S., 1854, p. 181, not of Defrance, 1827 (see Man. Conch. [I], xii, p. 269)+*Callina* Lwe., *t. c.*, p. 183, sole species *H. rotula* Lwe.

Shell brownish or variegated, depressed-globose, the periphery subangular or keeled, umbilicus narrow or closed. Surface scaly, striate or rather sparsely granulated. Aperture oblique, peristome expanded and thickened within, its margins not much converging, parietal callus usually rather slight. Type *G. lentiginosa* Lwe., pl. 68, figs. 4, 5 (see also pl. 68, fig. 7, *G.* [*Callina*] *fausta*).

Distribution, mainly Madeira.

(Perforate or umbilicate, the callous of basal lip not toothed, *Actinella.*)

G. lentiginosa Lwe., iv, 38.
G. actinophora Lwe., iv, 40.
v. descendens Woll.
G. stellaris Lwe., iv, 38.
G. arcta Lwe., iv, 38.
G. arridens Lwe., iv, 40.

(Imperforate or nearly so, compact, granulate, basal callus strong and truncate, *Callina.*)

G. arcinella Lwe.,
G. fausta Lwe., iv, 40.
v. robusta Woll.
G. obserata Lwe., iv, 40.
v. bipartita Woll.. iv, 40.
G. capsella Lwe., iv, 41.
G. rotula Lowe, iv, 46.

Subgenus Caseolus Lowe, 1852.

Caseolus Lowe, Ann. Mag. N. H. (2), ix, Feb., 1852, p. 115, for *sphærula, compacta, abjecta;* P. Z. S., 1854, p. 184, type *H. compacta* Lwe.—+*Hystricella* Lwe., P. Z. S., 1854, p. 186, type *H. bicarinata* Sow.+*Discula* Lwe., *t. c.*, p. 116; P. Z. S., 1854, p. 187, type *H. polymorpha* Lwe.+*Tectula* Lwe., *t. c.*, p. 117; P. Z. S., 1854, p. 191, type *H. bulveriana* Lwe.—*Turricula* Woll., Test. Atlant., p. 168, type *H. cheiranthicola* Lwe. (1878). Not *Turricula* (Klein) H. & A. Ad.=*Turris* Montf.

Shell perforate or umbilicate, varying from globose-depressed with rounded periphery, to subdiscoidal or to pyramidal, with keeled or double-keeled periphery. More or less granulated. Aperture rounded or oval, the lip blunt, usually a little expanded at columella. Type *G. compacta*, pl. 68, fig. 19 (see also *G.* (*Hystricella*) *bicarinata*, pl. 68, fig. 12; *G.* (*Discula*) *polymorpha*, pl. 68, figs. 8, 9.)

(Perforate; globose-depressed or globose-conic, *periphery rounded or bluntly angular, parietal lip adnate;* surface striate and granulate above, smooth or granose below; *color whitish.* Caseolus).

G. consors Lwe., iv, 39.
G. calculus Lwe., iv, 39.
G. compacta Lwe., iv, 39.
innominata Gray.
G. sphærula Lwe., iv, 39.
subcallifera Lwe.
G. abjecta Lwe., iv, 39.
v. candisata Mke.
G. commixta.

(Perforate, *trochiform,* with *acutely keeled or double-keeled periphery;* parietal lip raised and free; surface *sharply granose throughout;* color dusky. Hystricella).

G. echinoderma Woll., iv, 34.
G. echinulata Lwe., iv, 33.
G. bicarinata Sowb., iv, 33.
duplicata Lwe.
G. vermetiformis Lwe.
G. turricula Lwe., iv, 33.
v. pererosa Woll.
G. leacockiana Woll., iv, 34.
G. oxytropis Lwe., iv, 33.

(*Umbilicate,* much banded and varied with brown; depressed, *subdiscoidal* or pyramidal, carinated; surface smoothish, inconspicuously granular. Discula).

G. tetrica Paiva., iv, 44.
G. polymorpha Lwe., iv, 44.
elegantula Jan.
saccharata Lwe.
tæniata Rv.
v. salebrosa Lwe., iv, 44.
v. poromphala Lwe., iv, 44.
v. pittæ Pva., iv, 44.
v. alleniana Pva., iv, 45.
v. lincta Lwe., iv, 45.
v. arenicola Lwe., iv, 45.
cinerea Lwe., iv, 45.
v. barbosæ Pva., iv, 45.
v. pulvinata Lwe., iv, 45.
v. papilio Lwe., iv, 45.
calcigena Lwe., iv, 45.
v. discina Lwe., iv, 45.
v. gomesiana Pva., iv, 45.
v. attrita Lwe., iv, 46.
G. cheiranthicola Lwe., iv, 46.
v. mustelina Lwe., iv, 46.
G. tabellata Lwe., iv, 46.
G. testudinalis Lwe., iv, 46.
bulveriana var., Rv.
G. lyelliana Lwe., iv, 41.
G. albersi Lwe., iv, 42.
G. bulverii Wood, iv, 42.
bulveriana Lwe.

(Umbilicate, lenticular, with a compressed and deflexed keel; base coarsely granose; texture chalky; white).

G. tectiformis Sowb., iv, 42.
var. ludovici Alb., iv, 42.

Section *Disculella* Pils., 1894.

Ochthephila Beck, Index Moll., p. 17.—Albers-Martens, Die Hel., p. 118, type *H. maderensis*. Not *Ochthiphila* Fallén, 1823 (*Diptera*).—*Placentula* Lowe, Ann. Mag., Nat. Hist. (2), ix, p. 118, Feb., 1862; P. Z. S., 1854, p. 194, type *H. maderensis*. Not *Placentula* Lam., 1822.

Shell discoidal, umbilicate, with convex base and spire, the periphery keeled; solid, brown or whitish banded and maculated with brown. Surface striate above, smoother below. Whorls about 6, the last deflexed; aperture *circular*, oblique, the lip slightly expanded, narrowly white lipped within. Type *G. maderensis*, pl. 68, figs. 10, 11.

Distribution, Madeira Is. Distinguished from the very closely allied section *Discula* by the smoother, hardly granulate surface, and the rounder mouth.

G. compar Lwe., iv, 37.
G. tæniata W. & B., iv, 37.
G. maderensis Wood, iv, 37.
cyclostoma Mke.
G. spirorbis Lwe., iv, 41.
G. leptosticta Lwe., iv, 37.
G. micromphala Lwe., iv, 37.
G. dealbata Lwe., iv, 38.
G. fictilis Lwe., iv, 38.

Subgenus HETEROSTOMA Hartman, 1844.

Heterostoma HARTMAN, Erd- und Süsswasser Gasteropoden der Schweiz, mit zugabe einiger merkwürdigen exotischen Arten, p. 177, type *H. semitecta* Hartm., pl. 62 (vii), f. 1–4, = *H. paupercula* Lwe.

Shell small, *planorboid*, umbilicated, angular or keeled at periphery, with 4 to 5 whorls, the last deflexed, *abruptly contracted at the aperture, the lip-edge thin and slightly expanded*, continuous; basal lip strongly arcuate, with *a heavy callous rib within, which ends in a tooth* within the outer lip; parietal wall elevated. Type *G. paupercula* Lowe, pl. 68, figs. 16, 17, 18.

The two species grouped here have been widely separated in former classifications.

G. paupercula Lwe., iv, 35.
semitecta Hartm.
tracheloides Mke.

G. coronata Desh., iv, 34.
juliformis Lwe.

Subgenus GEOMITRA Swainson, 1840.

Geomitra Sw., Malacology, pp. 166, 332, type *H. tiarella*.—*Coronaria* LOWE, Ann. Mag. (2), ix, p. 117 for *coronula* and *tiarella*; P. Z. S., 1854, p. 193, type *tiarella* (preoc.).—*Craspedaria* LOWE, *t. c.* p. 117, and P. Z. S., 1854, p. 192, type *H. delphinula*.

Shell depressed or conoidal, solid, dull brown, rudely sculptured; *whorls of the spire plicate below the sutures*, more or less keeled at periphery; base cylindrical, umbilicated, *sculptured with granose spiral cords*. Aperture nearly round, very oblique, the *peristome expanded, thin, continuous*, solute, the parietal callus raised from the preceding whorl. Type *G. tiarella* Webb & Berthelot, pl. 68, fig. 6. (See also pl. 68, figs. 1–3, *G. delphinula*).

Jaw (of *tiarella*) low, slightly arcuate, the anterior surface with about 15 flat, broad, crowded ribs, scarcely denticulating the cutting margin. (*Binney*).

Radula with 12. 9. 1. 9. 12 teeth of same character as figured for *Plebecula lurida*.

Distribution, Madeira. This group is extremely peculiar in the coarse spiral sculpture of the base, and the coronated whorls of the spire.

Swainson in his first reference to this group figures the *H. tiarella*, but does not mention it by name. In his later reference he confuses *tiarella* with the figure and description of *H. bicarinata* Sow., but his diagnosis shows clearly the species intended.

G. tiarella W. & B., iv, 35.
G. moniziana Paiva., iv, 34.
G. coronula Lwe., iv, 34.
G. grabhami Woll.
G. delphinuloides Lwe., iv, 34.
G. delphinula Lwe., iv, 44.

Genus HELICELLA Férussac, 1819.

Helicella Fer., Tableau Syst. de la Fam. des Limaçons, p. 37 (fourth group only).—Risso, Hist. Nat. Eur. Mérid. p. 67, 1826, in part.

=Xerophila Held, 1837 and of subsequent authors, with *Helicopsis* Fitz, 1833, *Zenobia* and *Jacosta* Gray, 1821, etc., etc.

Shell umbilicate or perforate, with either cylindrical or keeled whorls; opaque and earthy, white or whitish and usually banded, not hairy; aperture round-lunate or angular, not very oblique, the lip acute, hardly expanded, thickened within (See pl. 68, figs. 20 to 30.)

Jaw with 4–11 wide, flattened ribs (pl. 67, figs. 12, 14).

Radula (pl. 67, fig. 13 *H. caruanæ* v. *gattoi*) with teeth of the type usual in ground-snails. Median teeth with weak ectocones or none, laterals with small divergent ectocones. On the marginals the inner cusp is either simple or bifid, outer cusp single or split (see also pl. 67, fig. 16, *H. terrestris*).

Genital system (pl. 69, all figs.) having the penis rather short, continued in an epiphallus bearing retractor, and ending in a short flagellum. Dart sack single or paired, with or without accessory sacks, and containing curved darts which are two-bladed at least toward the point. Mucus glands simple and tubular, several in number or numerous, but inserted individually on vagina. Spermatheca oval or irregular, borne on a rather short, unbranched duct. *Right eye-retractor passing to the left of genital system*, not between its branches.

An exception to the above diagnosis occurs in *Theba*, where the penis lacks retractor-muscle, and the dart sack is empty (pl. 69, figs. 14, 16, 22). In many species a sack-like organ or appendix, of unknown function is developed on the penis or on the atrium; and in

certain forms a spermatophore of unusual size is found, having the rod-like form and chitinous texture noticed in *Leptaxis*, but with serrate edge.

Helicella is allied to *Hygromia* in the simple-lipped shell, simple form of dart and frequent duplication of the dart sack. It differs from *Hygromia* in having the right eye-retractor pass to the left of the genital system instead of between its branches, and in the solid, earthy white shell. Outside of these two European groups the double dart sack occurs only in the Mexican genus *Lysinoe*. The peculiar disposition of the right eye retractor muscle occurs again in *Leucochroa*.

The species are very numerous throughout the Mediterranean countries, and many of them show a considerable range of individual variation, and also local or geographic racial forms; but the number of true species or subspecies is not over one-fourth the number of nominal species, mostly described by authors of the so-called Nouvelle Ecole of France. No individual variation is too slight to be called a "species" by some of these writers; and a large list could readily be given of "species" founded merely on *young shells* of well-known forms. Unfortunately for science, many of these worthless names, even some demonstrated to be the young of other species, have been adopted into works supposed to be authoritative, such as Westerlund's "Fauna." The result is that in Europe, where from the number of workers one would expect that the fauna would be well worked up and understood, the study of Helices is in a semichaotic condition so far as species work is concerned, and infinitely behind the condition of the science in America, the West Indies or Australia.

The tertiary deposits of Europe have afforded but few members of this genus; and although recorded from lower Miocene deposits, there are few if any undoubted representatives earlier than Pleistocene. This seems to indicate that the group is comparatively new to middle European soil.

The present group has usually been called *Xerophila* by recent authors; but several terms proposed by Risso and Gray precede Held's publication, besides the still earlier Férussacian name *Helicella*. Even were we to reject Férussac's term, the next name in order would be *Jacosta* Gray, 1821, founded on *H. explanata*. In no case can one use *Xerophila* as a generic name without throwing the rule of priority to the winds. There are, however,

plenty of writers quite willing to do this. *Xerophila* has been used in Ornithology (P. Z. S. 1840, p. 175) but later in date than Held's publication.

The division of the genus into sections is difficult on account of the large number of species intermediate in form; and the data at hand are insufficient for their discrimination on anatomical grounds. It is further complicated by the number of names proposed for members of the group, and their intricate synonymy. Although perhaps fairly able to distinguish small systematic groups, the writer claims to be no expert in perceiving the subtle distinctions made by some authors in this genus. Those who find a greater number of sections useful should avoid two radical faults in the present European usage: *i. e.* the use of preoccupied names and the use of old names for groups containing *none* of the species on which such sectional terms were originally based. Monterosato has recently proposed an entire new set of no less than forty-one sectional names, which for uniformity all begin with *Xero-*. There is much dry humor in this proposition, for he ignores all previous sectional nomenclature except *Xeroleuca*, and the new terms are mostly Greek **X** Latin hybrids, hideous in etymology and senseless in meaning.

Subgenus HELICELLA, penis retractor muscle present and well developed.	Xerocrassa Monts.	Jacosta Gray.
	Heliomanes Moq.	Xeroleuca Kob.
	Helicella *s. str.*	Obelus Hartm.
	Xerocampylæa Kob.	Trochula Schlüter.
	Candidula Kob.	Cochlicella Risso.
	Monilearia Mouss.	
Subgenus THEBA, no penis-retractor muscle. Muscus glands present. No dart in the empty sack.	Theba Risso.	
	Lejeania Ancey.	
	Platytheba Pils.	

Section *Xerocrassa* Monterosato, 1892.

Xerocrassa MONTS., Moll. Terr. Is. adiacenti Sicil., p. 23, type *H. seetzeni*.

Shell narrowly umbilicated, thick solid and chalky, varying from discoidal to turbinate. Type *H. seetzeni*.

A desert form of *Heliomanes* characteristic of Palestine and Arabia, perhaps worth a sectional name.

H. seetzeni Koch, iii, 223.
sabœa Boiss.
f. fasciata Mouss.
f. subinflata Mouss.
f. avia West.
H. beadlei Pils., viii, 176.
H. eremophila Boiss., iii, 242.
cremnophila Boiss. err. typ.
v. amuniensis Mts.
H. erkellii Kob., iii, 243.
v. discrepans Pils., viii, 177.
H. sinaica Mart., viii, 178.
H. psammita (B.) West.

Section *Heliomanes* Moquin-Tandon, 1855.

Heliomanes (Fér., Tabl. Syst., not used in a generic or subgeneric sense) Moq.-Tand., Hist. Nat. Moll. Fr., p. 259, and of subsequent authors.—*Xeroampulla* Monts., Moll. Terr. Is. Adi. Sicil. 1892, p. 22 (for aradasii, subprofuga, pellucens, enhalia).—*Xerofusca* Monts. *l. c.* (for luctuosa, benoiti, etc.).—*Xerolauta* Monts., *t. c.*, p. 23 (for virgata, variabilis, lauta).—*Xerolincta* Monts., *l. c.* (for arenarum, astata, euetha).—*Xerolæta* Monts., *l. c.* (for ægusæ, tuta, edulis, variata, rufolabris).—*Xerovaria* Monts., *l. c.* (for tergestina, stroniana, lineata).—*Xerambigua* Monts., *t. c.*, p. 24 (for dantei).—*Xerolutea* Monts., *l. c.* (for luteata, luteola, dautezi, melania).—*Xeromagna* Monts., *l. c.* (for cespitum, introducta, marioniana).—*Xeropicta* Monts., *l. c.* (for krynickii).—*Xerobulla* Monts., *l. c.* (for bollenensis, robiniana, perroudiana).—*Xeromunda* Monts., *t. c.*, p. 25 (for turbinata, candiota).—*Xerocauta* Monts., *l. c.* (for cretica, cauta).—*Xerovera* Monts., *l. c.* (for subrostrata, lacertarum, mauritanica, oranensis, cyclostoma, sphærita, caruanæ, galloi, metabola, rusticana, fraudulenta).—*Xerolissa* Monts., *l. c.* (for acompsia, acompsiella).

Shell with moderate or small umbilicus, conoidal or low conoidal spire and rather tubular, unkeeled whorls. Surface nearly smooth; solid and chalky, whitish and often banded or striped. Aperture rounded-lunar, lip acute, labiate. Type *H. variabilis* Drap., pl. 68, fig. 20.

Genital system (pl. 69, figs. 1, 2 *H. variabilis*): Dart sack containing a slightly curved dart (fig. 1), and with an accessory sack; mucus glands with numerous tubes. In some forms two dart sacks are developed (see also pl. 69, figs. 3, 4, 5, *H. virgata*).

This group contains the largest species of the genus. The whorls are less tubular than in *Helicella s. str.* and the spire generally higher, umbilicus smaller. Some species have one, others two functional dart sacks. The distribution is the same as that of *Candidula*—middle Europe north to England, and south to northern Africa.

Species numerous, but multiplied to an almost inconceivable number by the "new school" conchologists.

H. sitifiensis Bgt., viii, 165.
H. sphærita Hartm., iii, 249.
H. stiparum Rm., iii, 241.
H. submaritima Desm.
lauta Lwe., iii, 235.
H. subrostrata Fér., iii, 231.
H. terveri Mich., iii, 240.
arenivaga Mab.
luci Flor.
adoliæ Flor.
H. turbinata Jan., iii, 234.
cyclostomoides Porro.
pilula Mouss.
H. ungeri Zel.
H. variabilis Dr., iii, 230.
striata Brard.
zonaria Don.
subalbida Poir.
burdigalensis Grat.
lautaretina Bgt.
jussiana Bgt.
grannonensis Bgt.
salentina Bl.
mendranoi Serv.
v. turbinata Cafici.
variata West.
H. variegata Friv., iii, 235.
v. pustulosa Parr.
H. vestalis Parr., iii, 240.
? *mesopotamica* Mouss.
v. foveolata West.
H. virgata DaC.
H. zaccarensis Kob., viii, 168.
H. krynickii Andr., iii, 247.
babondubii Parr.
theodosiæ Cl.
radiolata Mss., iii, 240.
v. candaharica Pfr., iii, 247.
H. lampedusæ Kob., viii, 175.
H. laurinæ Iss., viii, 166.
H. luteata Parr., iii, 231.
f. subluteata Serv.
f. matronoi Serv.
H. maritima Dr.. iii, 235.
lineata Oliv. not Say.
pseudenhalia Bgt.
canariensis Sh.
H. mauritanica Bgt., iii, 235.
H. millepunctata Bttg., viii, 178.
H. modica Mouss., iii, 236.
H. moesta Parr., iii, 233.
v. luctuosa Caf.
H. moneriana Bgt., viii, 165.
H. oranensis Morl., iii, 249.
H. parva Parr., iii, 232.
H. pellucens Sh., iii, 232.
H. piratarum Kob., iii, 240.
H. richardi Kob., viii, 174.
H. sebkarum Deb., viii, 167.
H. semenowi Mart., iii, 237.
H. simulata Fér., iii, 232.
? *striatula* Bk.
H. derbentina Andr., iii, 247.
v. caucasica Parr.
v. depressa Ret.
v. isomera Friv.
v. armeniaca Bay.
v. suprazona Mss.
v. suberrans Mss.
v. constricta West.
H. devauxi Deb., iii, 240.
H. didyma West.
thiesseæ Mouss., iii, 24.
H. djebbarica Bgt., iii, 236.
H. dragorichi Zel., iii, 249.
H. durieuri Moq., iii, 236.

H. erithrocheila Sul., viii, 189.
rufolabris Ben. not Jeffr., iii, [233.
H. euphorca Bgt., iii, 230.
H. euxina Cl., iii, 231.
H. fabriesi Deb., viii, 168.
H. globuloidea Terv., iii, 243.
arenarum Bgt.
H. gouini Deb., viii, 170.
H. hamilcaris Kob., iii, 233.
H. herbicola Sh.
H. hydruntina Bl., iii, 230.
H. joppensis Roth, iii, 244.
bargesiana Bgt., iv, 7.
f. subkrynickiana Mouss.
f. multinotata Mouss.
? *mesopotamica* Mss.
H. caruanæ Kob., viii, 174.
v. gattoi Kob., viii, 175.
H. cauta West., iii, 240.
H. cespitoides Fisch., viii, 176.
H. cespitum Drap., iii, 241.
carnina Cheir.
eurythmia Hartm.
v. dismathia Nev.
v. alticola Nev.
v. introducta Zgl., iii, 242.
H. chalcidica Bl., iii, 24, 231.
H. choreta Bgt., iii, 231.
H. cistorum Mor., iii, 236.
H. colomiesiana Bgt., iii, 232.
H. commeata Mouss.
H. cottyi Mor., iii, 236.
H. cretica Fér., iii, 239.
v. littoralis Mouss.
v. akrotirensis Kob.
H. critica Fér.
H. cyrenaica Mts., iii, 234.
H. danieli Bgt., iii, 230.
H. dautezi Kob., iii, 248.
H. davidiana Bgt., iii, 24.
H. accompsia Bgt., iii, 231.
v. accompsiella Anc.
H. adolphi Pfr., iii, 241.
H. ægusæ Kob.
H. affinior Deb., viii, 166.
H. agreabilis Zgl., iii, 234.
H. amoma Bgt.
H. aradasii Piraj., iii. 233.
filograna Villa.
H. arcuata Zgl., iii, 234.
H. arigonis Rm., iii, 241.
arigoi Bgt.
H. armoricana Bgt., iii, 242.
H. benoiti Caf., iii, 233.
H. berlieri Morl., iii, 236.
? *lacertarum* Bgt.
H. bollenensis Loc., viii, 170.
lauracina Fag.
H. breveti Deb., viii, 169.
H. calida Kob., viii, 167.
H. calopsis Bgt., viii, 165.
H. camerata Mouss., iii, 232.
H. candiota Friv., iii, 234.
H. canina Anc., viii, 177.

Unfigured, insufficiently known species:—H. mayeti, valeryana, eumona, pachesta, charmesiana, bilottiana, blossura, elithia, arbana, ionstoma, ianthinostoma, amethysta Let. & Bgt.; bousqueti (Deb.) W.; casertana B.; tacapica, tabarkana, una, tebourbana Let. & Bgt.; therella (Berth) B.; thera Let. & Bgt.; foedata (Hagenm.) B.; tæniata W.; dexia, neftana B.; libertina (Let.) W.; pompeiana B.; desilvæ Serv.; ogiaca Serv.; microspila B.; euxina Cl.;

salentina (Bl.); privata Galland; zerguana (Hagenm.); philoxera Caf.; euetha (B.); limara B.; erythræa W.; halophila (Deb.); xera (Hagenm.); mahdarina B.; didiera (B.); nya, latastei Let.; latasteopsis, fratisiana, tafermica, mezessaria Let. & Bgt.; æstuosa Berth.; inversa, æqua W.; zemonicensis Stoss.; naudieri B.; eusarca Anc.; eusarcomæa Anc.; occonella Let. & Bgt.; steriolena, adisana Bourguignat; psammathæa Let. & Bgt.; bertina B.; etæma Let. & Bgt.; menzelensis Letourneaux & Bgt.; ramlensis B.; comendadori Serv.; panurga B.; euphorcella Pech.; euphorcopsis, esnorca Let.; meticulosa Let. & Bgt.; carpensoractensis Fag.; robiniana B.; foliorum Fag.; prinohila Mab.; perroudiana Loc.; visanica Fag.; taria B.; vettonica Serv.; maxulana Let. & Bgt.; entara, zitanica Let. & Bgt.; rhodochila W.; lotophagorum, meninxica, mesembrica Let. & Bgt.; mantinica Mab.; locardi W.; panescorsi Béreng.; dantei, calopsis B.; eucestella, eucesta B.; ammederana, haidrana, birta Let. & Bgt.; dolomitica Deb.; rachgonica B.; kabyliana Deb.; euthymeana Loc.; actia B.; actiella, nautica, suberis Loc.; evenosi B.; maristorum Flor.; cyclostoma W.; axiotheata B.; lemoinei Deb.; ferianica Let. & Bgt.; oreta B.; pedianopsis Hagenm.; certa B.; caudefacta Let. & Bgt.; leucophora, ingenua, acela, monerea, chioidea B.; phoebeia Let. & Bgt.; spilmenti, catarota, cana, leucestha B.; hadrumetorum Let. & Bgt.; urbarana Pech.; eucana Hagenm.; barrattei, slouguia, khangetina, artara, burella, boudriesa Let. & Bgt.; armoricana, anephela, pediana B.; ripacurcica Bofill; ilicis Florence; megastoma B.; cælestis Let. & Bgt.; meteora B.; suspecta W.; talepora, acosmeta B.; lersiana Fag.; calographa W.

Section *Helicella* s. str.

Helicella Fér. *t. c.* (in part).—Risso, *t. c.*, p. 67, in part, and of authors.—*Planatella* Clessin, Deutsche Exc. Moll. Fauna, 1876, p. 143 (for *ericetorum* and *candicans*), Mollusken fauna Oesterreich-Ungarns und der Schweiz, 1887, p. 180.—*Xerolaxa* Monterosato, Moll. Terr. delle Isole adiacenti Sicilia, p. 24, from Atti della R. Accad. di Scienze, Lettere e Belle Arti, (3), ii, 1892, (for ericetorum, pamplonensis).—*Xerofriga* Monts. *l. c.* (for nubigena).—*Xerogyra.* Monts., *l. c.* (for spadæ, bathyomphala).—*Xerocincta* Monts., *l. c.* (for neglecta).—*Xerolenta* Monts., *l. c.* (for obvia, derbentina).—*Pseudoxerophila* Westerl. Aperçu Faun. Mal. Grèce, 1879, p. 55 (for bathytera, etc.).

Shell much depressed and broadly umbilicated, with smoothish, tubular whorls, rounded at periphery, and of the usual chalky texture and white, banded coloring. Aperture small, round or oval; but little modified by the preceding whorl, the lip slightly expanded Type *H. ericetorum* Müll., pl. 68, figs. 21, 22.

Jaw arched, strongly ribbed. Genital system (pl. 69, figs. 6, 7, 8, *H. ericetorum*) with short swollen penis, long epiphallus upon which the retractor is inserted, and very short flagellum. High on vagina are two symmetrically placed dart sacks (fig. 7), containing well curved round darts, provided toward the end with two narrow blades (fig. 8). Mucus glands numerous.

H. aberrans Mouss., iii, 246.
H. ammonis Schm., iii, 245.
f. candida Porro.
v. sclerostoma Stef.
v. bononiensis Stef.
v. bonaldi Ad.
H. apollinis Mts.
H. bathytera Bl. & W.
f. affinis Bl.
H. bathyteropsis Serv.
H. enhalia Bgt., iii, 243.
H. ericetella Jouss., iii, 243.
H. ericetorum Müll., iii, 245.
trochlearis Andrz.
küsteri Held.
? *itala* L. *media* Gm.
dubia Hartm.
f. devians West.
erica DaC.
obliterata Hartm.
f. tardyi Bgt.
H. gyroides Parr., iii, 246.
H. instabilis Zieg., iii, 248.
neopolitana Andr.
spadæ Calc.
nubila Charp.
ocellus Villa.
v. nubigena Charp. vi, 84.
v. bathyomphala Charp.
v. destituta Charp.
v. discrepans Tib.
v. græca Mart.
? *iphigeniæ* Deb.
H. interpres West., iii, 242.
H. lemoinei Deb., iii, 246.
H. neglecta Drap., iii, 243.
clivorum Hartm.
varians Risso.
H. obvia Mke.
candicans Auct., iii, 244.
v. arenosa Z., Rm.
v. dejecta Z., Rm., iii, 246.
v. renoufi Serv.
v. pullula Parr.
v. dobrudschæ Parr.
v. græca Mts.
H. pamplonensis Schm., iii, 246.
H. spirula Zel., iii, 249.
v. bakowskyana Cl., iii, 248.
H. talmacensis Blz.
H. vukotinovici Hirc., iii, 246.
liburnica Stoss.
H. vulgarissima Mouss., iii, 245.

Insufficiently known or unfigured species:—H. virgultorum Bgt., morbihana Bgt., fagoti West., dysmica West., synerosa Serv., sal-

aunica Fag., maladettæ (B.) Fag., sabulivaga and marsillyana Mab., nephæca Fag., homoleuca Parr., tauchoniana Bgt., tenuisculpta West.

Section *Xerocampylæa* Kobelt, 1871.

Xerocampylæa Kob., Catalog, p. 15, footnote, for *H. zelebori.*

Shell depressed with horn-colored apex and wide last whorl with rounded periphery; rather thin and white with 2 bands (or none). umbilicus funnel-shaped but very small. Aperture transverse oval, the lip dilated at columellar insertion partly covering umbilicus. Type *H. zelebori* Pfr., pl. 43, figs. 29, 30.

Genital system as in *Helicella*, two dart sacks being developed. Distribution, Bosnia, Servia. Formerly referred to *Campylæa*, but now admitted to belong to the *Xerophila* group.

H. zelebori Pfr., iv, 83.

The following forms or varieties of *Zelebori* are distinguished by French new school authors: *bortana, adarella, carosina, ottoi, twartkoi, nactara* and *acaria* Servain.

Section *Candidula* Kebelt, 1871.

Helicopsis Fitz., Syst. Verzeich Weichthiere, etc., 1833, p. 101. *H. striata* the sole species. Not *Helicopsis* Fab., 1808 (*Lepidoptera*), —*Striatella* Westerlund, Fauna Eur. 1876, not of Brot (*Melaniidæ*).—*Candidula* Kobelt, Catalog., 1871, p. 22.—*Xerolena* Monts., Moll. Terr. Isole adiacenti Sicil. 1892, p. 22 (for *H. virginalis, hamilcaris, ingoi*).—*Xerotringa* Monts.. *l. c.* (for *H. tringa, phari, parentina, meridionalis, substriata*),=group *Cisalpinana* Fagot.—*Xerovaga* Monts., *l. c.* (for *H. caperata, heripensis, gigaxii, andalusica*). —*Xeroalbina* Monts., *t. c.*, p. 23 (for *candidula, unifasciata, gratiosa, striata*).—*Xeromicra* Monts., *l. c.* (for *H. apicina*).—*Xerotricha* Monts., *l. c.* (for *H. conspurcata*).—*Xeroclausa* Monts., *t. c.*, p. 22 (for *meda*).—*Striatella* Clessin, Deutsche Exc. Moll. Fauna, p. 149 1876, (for *H. candidula, H. striata*).

Shell rather small, depressed, narrowly umbilicated, solid and chalky; the surface striated; apex corneous or dark; whorls about 4½, the last rather wide and rounded. Aperture round-lunate, lip simple, strengthened by a submarginal rib within. Type *H. candidula*, pl. 68, fig. 28.

Genital system (pl. 69, fig. 10, *H. candidula*). Dart sack single and simple; mucus glands consisting of four tubes. Appendix wanting. Flagellum very short. See also pl. 69, fig. 9, *H. caperata*. In some species (pl. 69, fig. 13, *H. striata*) there are two dart sacks with two accessory sacks, and about 11 mucus glands.

Distribution, Middle Europe and circum-Mediterranean region.

It is probable that two sections will be distinguished in this group, the division to be based on the number of dart sacks; but at present so few spceies have been dissected that such division is not possible,

H. acutistria Bttg., iv, 10.
H. agrioica Bgt., iv, 9.
H. andalusica Kob., viii, 160.
H. apicina Lam., iv, 5.
cenisia Charp.
hispidula Risso.
cupani Calc.
v. ramburi Mab., iv, 6.
v. requieni Moq.
v. mühlfeldtiana Zgl.
v. citharistensis Bgt.
v. psaropsis Loc.
v. marsiana Bgt.
H. armillata Lowe, iv, 15.
lowei P. & M.
eumœus Lwe.
H. arrouxi Bgt., iv, 12.
H. bardoensis Bgt., iv, 7.
H. braidensis Poll.
H. calymnia Mts., viii, 179.
H. camerata Mouss.
H. candidula Stud., iv, 10.
unifasciata Poir.
bidentata Dkr.
graphiea Hartm.
rugellosa Hartm.
striatula Hartm.
azona Andr.
unizona Andr.
radiolata Andr.
elegans Flem.
solitaria Poir.
v. alpicola Stab., iv, 10.
v. thymorum v. Alt. iv, 10.
v. gratiosa Zgl., iv, 10.
strigatula Hartm.
adnumerata Parr.
v. spirilla West.
v. vortex West.
v. albocinctella Colb.
v. namurcensis Colb.
v. lunulata Kryn.
v. mellæ Pini.
v. iriana Poll.
v. vincæ Paul.
H. cantabrica Hid.
H. caperata Mont., iv, 14.
v. lauta Lwe.
v. barcinensis Bgt., iv, 14.
mirandœ Ramb.
iberica Ramb.
v. diniensis Ramb.
H. carascalensis Fér., vi, 103.
H. cisalpina Jan.
H. cistorum Morel.
H. codia Bgt., iv, 16.
H. conspurcata Drap., iv, 12.
radiolata Jan.
œtnœa Ben.
v. illuviosa Nev.
v. psara Bgt.
H. cyparissias Parr., iv, 11.

H. derogota Rm., iv, 23.
v. angulata Rm., iv, 23.
murcica Guir.
H. diensis Malz., viii, 162.
H. dohrni Paul., viii, 173.
H. etrusca Iss.
H. eustricta Bgt., iv, 13.
H. fedtschenkoi Mart., iii, 24, [iv, 9.
H. geryvillensis Bgt., iv, 6.
H. gigaxii Charp., iv, 16.
H. guimeti Bgt.
H. hellenica Bl. & W., viii, 163.
v. contempta Parr.
H. heripensis Mab., viii, 158.
ruida (B.) Cout.
pouzonensis Fag.
v. solaciaca Mab., viii, 159.
H. heynemanni Kob., viii, 169.
H. illibata Parr., iii, 249.
H. improbata Mouss.. iv, 12.
H. intersecta Mich., iv, 13.
ignota Mab.
H. jaylei Pal., viii. 164.
v. rusticula Pal., iv, 14.
H. kotschyi Pfr.
H. lallemantiana Bgt., iv, 6.
H. langloisiana Bgt., iv, 15.
H. letourneuxiana B., iv, 12.
H. locheana Bgt., iv, 13.
H. loroglossicola Mab., viii, 159.
H. madritènsis Ramb., iv, 16.
H. meda Porro, iv, 17.
subclausa Rm.
turatii Parr.
calypso Parr.
H. meridionalis Parr., iv, 9.
H. mesostena West., viii, 175.
H. metabola West.
H. modica Morel.
v. attafsensis Morel.
H. molinæ Hid., iv, 15.
H. moricola Pal., iv, 13.
H. obruta Morel., iv, 6.
H. tuta Paul., viii, 173.
H. vatonniana Bgt., iv, 31.
florentiæ Pons., viii, 161.
H. velascoi Hid., vi, 103.
H. ordunensis Kob., viii, 161.
H. paladilhi Bgt., iv, 11.
H. parableta Bttg., iv, 8.
H. penchinati Bgt., iv, 16.
H. perroudiana Loc., iv, 8.
H. profuga Schm., iv, 7.
phari Fagot, iii, 241.
fasciolata Moq.
fimbriata Chier.
apennina Chier.
v. attica Bttg.
v. variegata Mouss.
v. comnena Ret.
H. protea Ziegl., iv, 5.
campestris Zgl.
pustulata Mühl.
H. psiloritana Malz., viii, 162.
H. quisquiliæ Paul, viii, 164.
H. reboudiana Bgt., iv, 6.
H. rokniaca Bgt., iii, 198.
H. rugosiuscula Mich., iv, 11.
H. sardiniensis Villa, viii, 164.
H. schaufussi Kob.
H. semipicta Hid., iv, 16.
H. striata Müll., iv, 7.
costulosa Zgl.
narbonensis Req.
v. nilssoniana Bk.
v. füredensis Serv.
v. bakonyca Serv.
v. plattenica Serv.
H. subapicina Mouss., iv, 6.
v istera Let. & Bgt.
H. subcostulata Bgt., iv, 9.

H. submeridionalis B., iv, 14.
H. subprofuga Stab.
H. substriata Cl., iv, 9.
H. subvariegata Malz., viii, 163.
H. trepidula Serv., viii, 171.
H. tricastinorum Flor., iv, 9.
H. tuta Paul., viii, 173.
H. vatonniana Bgt., iv, 31.
florentiæ Pons., viii, 161.
H. velascoi Hid., vi, 103.

Insufficiently known forms:—H. deana and H. pleurestha (Tassy) Berth., H. mediolanensis Fag., H. grandiscanensis Fag., H. aprutitiana Fag., H. florentina Fag., H. brundusiana Fag. H. muggianica Stoss., H. tringa Fag., H. ingoi Cafic., H. lesiniaca Fag., H. parthenia Hag., H. rhytiphora Chemn., H. herbatica Fag., H. kryzensis Bgt., H. solanoi Serv., H. ægila Loc., H. xalonica Serv., H. alluvionum Serv., H. odarsensis Fag., H. montgiscardiana Fag., H. grannonensis Bgt., H. canovasiana Serv., H. mendranoi Serv., H. blasi Serv., H. agna Hag., H. cyzicensis Gall., H. ariantina West., H. tremata Let. & Bgt., H. tritonidis Jon., H. fera Bgt., H. nova Bgt., H. subneglecta Bgt., H. phthiota West., H. pastorella West., H. curetum West., H. agreabilis Zgl., H. arcuata Zgl., H. samnitum and v. pugnax W., H. mehediana L. & B., H. ycaunica Mab., H. philomiphila Mab., H. vicianica Bgt., H. caturigia Paul., H. arceuthophila Mab., H. bardoensis Bgt., H. lecouffei L. & B., H. duveyrieriana Bgt., H. herbarum Serv., H. oberthuri Anc., H. incolumis Bgt., H. codia Bgt., H. subintersecta Bgt., H. strucki Mz., H. pictonum Bgt., H. olisippensis Serv., H. badigerensis Fag., H. monistrolensis Fag., H. idiophya Flor., H. callestha Béreng., H. tolosana Bgt., H. groboni Bgt. and v. xenilica Serv., H. lieuranensis Bgt., H. margieriana Fag., H. pauli Bgt., H. valcourtiana Bgt. and v. veranyi Bgt., H. crouziliana Fag., H. gesocribatensis Bgt., H. philora Bgt., H. thuillieri Mab. with v. nomephila Bgt., H. coutagnei Bgt. with vars. acentromphala and mauriana Bgt., H. lemesli Mab., H. scrupea Bgt., H. siticulosa Fag., H. diniensis Ramb., H. idanica Loc., H. cahuzaci Bgt., H. velaviana Bgt., H. triphera Bgt., H. jeanbernati Bgt., H. belloquadrica Mab., H. mouqueroni Bgt., H. leiolemma West., H. acosmia Bgt., H. microphana Bgt., H. ilicetorum Mab., H. garoceliana Loc., H. tarasconensis B., H. simiarum Kob., H. alavana Bgt., H. mascarenasi B., H. culmi Fag., H. segetum Fag., H. lunulata Kryn., H. elimberrisiana Loc., H. aurigerana Fag., H. lugduniaca Mab., with *f.* stictica W., H. ussatensis B., H. arelatensis Loc., H. lusoi Serv., H. saldubensis Serv., H. pinii West., H. arganica Serv., H. belemensis Serv., H. taconera Serv., H. mercedesi Serv., H. ramburi Mab., H. carcusiaca Mab., H. hypæana B., H. danieli B., H. deferiana B., H. lathræa B., H. melania B., H. halia B., H. salivosa B., H. barcinonensis Fag., H. madritensis

Ramb., H. pallaresica Fag., H. salvanæ Fag., H. chiæ Fag., H. moreri Fag., H. subiberica Fag., H. crisia Let. & Bgt., H. zaragozensis Serv., H. campoensis Fag., H. tarifensis B., H. specialis B., H. djebbarica B., H. warnieriana B., H. irrita Berth., H. debeauxi West., H. micromphalus Let., H. lirouxiana B., H. madida Fag., H. misara B., H. paladilhiformis Fag., H. romulina Serv., H. noctuella B., H. arnusi Serv., H. edetanorum Serv., H. ambieliana (Ch.) Pal., H. bradybæna L. & B., H. terricola B., H. galeomma B., H. æglia L. & B., H. argoderma B., H. briaræa B., H. aggarica B., H. eucorea B., H. amicula B., H. amphibola B., H. ambloxa L. & B., H. anasia B., H. goniogyra B.. H. concholeuca L. & B., H. vivida Hagenm., H. hipponensis Mor., H. isæa Hagenm., H. irana Hagenm., H. castroiana Serv., H. ademata B., H. avenionensis B., H. tassyana Fag., H. diloricata B., H. vafella L. & B., H. propria Gall., H. augustiana B., H. pisanorum B., H. luteola Serv., H. eucalia Hagenm., H. hispalina Serv., H. frayssina B., H. crema B., H. hola B., H. hierocontina W., H. hierapetrana Mz., H. colosseana Fag., H. romana Fag., H. fiesolensis Fag., H. membronica Berth., H. artonilla Hagenm., H. astonara Hagenm., H. pleurabdota B., with v. cacista B. and v. vaganensis Hag., H. perlutosa Hag., H. syntela B., H. saharica B., H. ischurostoma B., H. nahrouasselina B., H. honorati B., H. moricola Pal., H. tenietensis B., H. gibilmanica Serv., H. polytrichia Anc., H. longipila Mss., H. vestita Ramb., H. dumivaga Mouss., H. trutatiana Fag., H. renei Fag., H. oreina Fag., H. montivaga Fag., H. suborcina Fag., H. seirensis Fag., H. bradygyra Fag., H. carascalopsis Fag., H. esserana B., H. nansoutyana B., H. oppidi Fag., H. transfuga Fag.

Section *Monilearia* Mousson. 1872.

Monilearia Mouss., Rév. Faun. Mal. Canaries, p. 39.

In referring these minutely perforate, mostly well keeled forms to the Xerophila series, I am departing from ordinary usage, which has associated them with the Maderian group *Lemniscia*. In general appearance and sculpture, as well as in the structure of the basal lip, they do not agree with *Lemniscia* as well as with *Obelus*, *Candidula*, *Jacosta*, etc.

No type having been nominated for this group, I consider *H. phalerata* Webb & Berthelot such. The species are confined to the Canary Islands.

H. monilifera W. & B., iv, 20.
H. lancerottensis W. & B., iii, [237.
  v. webbii Lwe.
  v. bertheloti Lwe.
  v. adoptata Mouss.
H. persimilis Shutt., iv, 19.
  v. præposita Mss.
  v. devia Mouss., iv, 20.
H. phalerata W. & B., iv, 19.
  rosetti W. & B.
  nivariensis Sh., Rve.
H. umbicula Sh., iv, 21.
  roseti Pfr. not W. & B.
  phalerata Pfr. not W. & B.
H. cæmentitia Sh., iv, 20.
H. tumulorum W. & B., iv, 19.
  ? *atomata* Mke., iv, 21.
H. oleacea Sh., iv, 20.
  v. deusta Lwe.
H. woodwardia Tarn., iv, 20.
H. watsoniana Woll., iv, 21.
H. lemniscata W. & B., iv, 21.
H. orbignyi W. & B., iii, 237.
  orotavana Tarnier.
  v. mitigata Mouss.
  v. calcarea Mouss.
H. phryganophila Mab.
H. dendrophila Mab., iii, 237.
H. aglaometa Mab., iii, 237.

Section *Jacosta* Gray, 1821.

Jacosta Gray, London Med. Repos., xv, March 1, 1821, p. 236, only species mentioned *H. Jacosta albella* Drap.=*explanata* Müll.—*Numidia* Issel, Ann. Mus. Civ. Genov. xxii, 1885, p. 8, 9, type *H. idia* Bgt.—*Xerofalsa* Monts., Moll. Terrest. delle Isole adiacenti alla Sicilia, 1892, p. 21 (for *H. idia, enica, zougitana*).—*Xerosecta* Monts., *l. c.* (for *H. explanata*).—*Xeroplana* Monts., *l.* c. (for *H. doumeti, depressula*).—*Xerotropis* Monts., *t. c.*, p. 23 (for *gargottæ, jolyi, prietoi, ledereri, milaschewischi, spratti*).—*Xeroamanda* Monts., *t. c.*, p. 22 (for *amanda, usticensis*).—*Xeromoesta* Monts., *l. c.* (for *moesta, kabyliana, dormiens, dohrni*).—*Xerocodia* Monts., *t. c.* p. 23 (for *montserratica, penchinati, barneana*).—*Xeroplexa* Monts. *l. c.* (for *setabulensis, nyelli, coronadoi*).—*Tropidocochlis* Locard, Exchange ix, p. 97, 1893, type *H. explanata.*

Shell umbilicated, the *whorls flattened above,* acutely *keeled at periphery, and convex beneath;* surface costulate, striate or smoothish; solid and *earthy,* whitish with or without bands, the apex black or light. Aperture angled, the lip rather blunt, not expanded. Type *H. explanata* Müll., pl. 68, figs. 23, 24.

Jaw arcuate and ribbed. Genital system (pl. 69, fig. 15, *H. explanata*) with the flagellum rather longer than usual in the genus; dart sack slightly bilobed at apex and containing two darts; mucus glands numerous.

H. explanata shows clearly the transition between the species with one and those with two dart sacks. The second sack is formed by splitting of the first. In some other species of this keeled group the sack is apparently single and simple, as Schuberth has figured it for *H. syrosina.*

Jacosta is in all probability a purely artificial group, containing keeled forms which have arisen from several diverse stocks of unkeeled Helicellas; but only a thorough study of the shells and anatomy of many species can demonstrate the true origin of the several forms.

H. agona Anc.
H. amanda Rm.
limbata Phil.
v. dormiens Ben., iii, 252.
v. insularis Iss.
H. amphiconus Malz., viii, 180.
H. argonantula W. & B., iv, 42.
typica and canariensis Mss.
renati Dautz.
H. arianensis Bgt., iii, 253.
H. barceloi Hid., iii, 257.
H. barneyana Anc., viii, 183.
theodori Anc. *ms.*
H. biangulosa Mts., iii, 178.
H. boissyi Terv., iii, 254.
v. frater D. & H., iii, 258.
H. brondeli Bgt., iii, 255.
H. cardonæ Hid., iii, 258.
H. caroli D. & H., iii, 258.
H. cavannæ Paul, iii, 259.
v. scissa Paul.
H. cavimargo Mts.
H. cisternosi Hid., iii, 259.
H. columbina West.
H. corrugata Gmel., iii, 252.
rugosa Chem.
groyana Fér.
gargottæ Phil.
v. pleurischurra Bgt.
v. chonomphala Bgt.
H. crenimargo Kryn., iii, 252.
piatigorskiensis Bayer.
H. depressula Parr., iii, 256.
forms globulosa, flammulata, zonata, fulva, compressa Bgt., exserta, murustagensis West.
H. doumeti Bgt.
v. lacosteana Mor., iii, 255.
H. eminens West., viii, 180.
syrensis v. exserta Mts.
H. enica L. & B., viii, 182.
H. eugoniostoma Bgt.
H. explanata Müll.. iii, 255.
albella Dr.
f. minor Bgt.
f. subscalaris Bgt.
H. filimargo (Z.) Rm., iii, 251.
taurica Partch.
chersonesica Mühl.
H. finitima Mor., iii, 241.
H. gradilis Mts., viii, 179.
H. graja West.
v. philesia West.
H. granostriata Mouss., iv, 43.
H. grovesiana Paul, iii, 254.
H. hamudæ Kob., viii, 182.
H. hariotiana Bgt.
H. henoniana Bgt., iii, 254.
v. agriunensis Kob.
H. homeyeri D. & H., iii, 257.

H. idia L. & B., iii, 256.
H. ledereri Pfr., iii, 259.
f. regularis Roth.
H. moraguesi Kob., iii, 255.
H. micropristis Anc.
f. appressispira Anc.
H. milaschewitschi Ret.
H. morata Mouss., iv, 43.
H. montserratensis Hid., iii, 257.
H. multipunctata Mouss., iv, 43.
H. nummuliformis Ret.
H. nyelii Mitt., iii, 258.
H. orophea West.
H. parableta Bttg.
H. pollenzensis Hid., iii, 257.
H. ponsii Hid., iii, 257.
H. ponsonbyi Kob., viii, 183.
H. præclara Caf., iii, 252.
H. prietoi Hid., iii, 257.
H. pulverulenta Lwe., iv, 43.
H. retowskii Cless., iii, 252.
H. rouvieriana Bgt., iii, 255.
H. rozeti Mich., iii, 254.
v. oxygyra West.
H. rozetopsis L. & B.
H. setabulensis Pfr., iii, 256.
serrula Morel.
H. siderensis Malz., viii, 181.
H. sigensis Kob., iii, 256.
f. jolyi Pech., Anc.
H. siphnica Kob.
H. spratti Pfr., iii, 253.
siderites Friv.
v. perplanata Pils., viii, 181.
H. syrensis Pfr., iv, 28.
H. syrosina Bgt.
H. tineana Ben., iii, 253.
v. mista West.
v. kobeltiana W.
H. tissotiana Bgt.
H. tristrami Pfr., iii, 253.
H. usticensis Calc., iii, 254.
H. zeugitana L. & B., viii, 182.

Insufficiently known forms of Jacosta: H. chola Pech., caficii (Ad.) West., hierica Bgt., tineiformis Let. & Bgt., soleilleti Bgt., hodnæ Anc., melosina Bgt., sageti Bgt., orphea West., morini, chthamalolena, ablennia, hyperconica and tellica Bgt., eufidana callistoderma and conicula Let. & Bgt., mitidjana and bibanensis Anc., euphacodes and sphakiota Malz.

Section *Xeroleuca* Kobelt, 1877.

Xeroleuca Kob., Jahrb. D. M. Ges. 1877, p. 25.—*Conf.* Schepman, Jahrb. 1877, p. 271, 272, anat. of *mograbina* and *degenerans*.

Shell depressed and widely umbilicated, solid, whitish and *chalky*, having one, two or three spiral keels; *surface roughly sculptured*. Type *H. turcica* Chemn.

The species are mostly from Morocco. Genital system (pl. 69, fig. 11, *H. mograbina*) substantially as in *Helicella ericetorum*, but the dart sacks are smaller.

H. conopsis Mor., iv, 22.
H. turcica Chemn., iv. 22.
cratera Schum.
v. tetragona Mor., iv, 21.
H. degenerans Mouss., iv, 22.
f. validior Mouss.
H. mogadorensis Bgt., iv, 22.
H. cyclostremoides Sby., iv, 256.
H. mograbina Mor., iv, 22.
H. darolli (Let.) Bgt.
v. djarica Bgt.
H. tunetana Pfr., iv, 21.

Section *Obelus* Hartmann.

Obelus HARTM., Erd- und Süsswasser-Gast. Schweiz, p. 158, type *O. preauxii.*—*Xeroptyca* MONTS., Moll. Terr. Is. adi. alla Sicil., 1892, p. 25, type *H.* "*ptycodia*"=*ptychodia.*

Shell *trochiform,* with narrow umbilicus, acutely *keeled and serrate periphery* (at least when young), with usually a secondary keel or series of tubercles midway between periphery and suture; solid, whitish and earthy. Aperture basal, angular-oval, the lip simple but slightly dilated at columella. Type *H. despreauxii.*

Genital system (pl. 69, fig. 12, *H. tuberculosa,* typical); penis having a subterminal elongated appendix; other organs as in *Helicella ericetorum,* but dart sacks small.

Distribution, Canary Is., eastward to Syria. A very natural group, consisting of one series of species in Morocco and the Canary Is. and another in Lybia to Palestine. Monterosato's name *Xeroptyca* belongs to the latter, but it seems unnecessary to make any separation, and the term is etymologically bad.

H. tuberculosa Conr., iv, 25; [viii, 184.
v. serrulata Bk., iv, 25.
H. philammia Bgt., viii, 185.
H. ptychodia Bgt., viii, 184.
H. agenora West.
H. berenice Kob., viii, 185.
H. lybica Pons., viii, 185.
H. hesperidum Mor., iv, 26.
H. pumilio Pfr., iv, 27.
v. cyclodon W. & B., iv, 26.
H. despreauxii Orb., iv, 25.
preauxii Hartm.
v. immodica Mouss.
H. moderata Mouss., iv, 26.
H. mirandæ Lwe., iv, 26.
nodosostriata Mouss.

Section *Trochula* Schlüter, 1838.

Turricula BECK, Index Moll. 1837, p. 10, not *Turricula* Schum. Essai, 1817, p. 217 (*Pleurotomidæ*).—? *Oxynota* HARTM., Erd- und Süsswasser-Gast. Schweiz, 1842, p. 159, a nude name; no species mentioned.—*Crenea* ALBERS, Die Hel. 1850, p. 77, in part, not

Crenea Risso, 1826.—? *Trochoida* or *Trochoidea* Brown, Ill. Conch. G. B. 1827 (publication not seen).—*Xeroclivia* Monts., Moll. Terr. Is. adiac. alla Sicil., 1892, p. 25 (for *H. pyramidata*).—*Xeronexa* Monts., *l. c.* (for *H. cumiæ, calcarata*).—*Xerocochlea* Monts., *l. c.* (for *H. caroni, elata*).—*Trochula* Schluter, Syst. Verz., p. 7, 1838. —Morch, Journ. Conch. 1865, p. 386.

Shell solid and earthy, narrowly umbilicated, trochoidal, with conic spire, narrow whorls and rather flattened base; periphery somewhat angular or sharply keeled. Aperture small, lunate or angular, the lip not expanded, strengthened by a submarginal rib within. Type *H. terrestris* Penn., pl. 68, fig. 27.

Jaw with 8 to 18 close, flat ribs (pl. 67, fig. 12, *H. terrestris*).

Radula (pl. 67, fig. 16 *H. terrestris*) with mesocone about the length of basal-plate on median teeth, the side cutting points well developed. Laterals the same, but lacking entocones; on the transition teeth the inner cusps become bifid, and on marginals the ectocone also splits.

Genitalia (pl. 69, fig. 18 *H. elegans*); dart sacks two, very small. Mucus glands 6. At base of vagina or on the atrium a large sack-like appendicula. Other features as in *Helicella* generally.

Mainly a circum-Mediterranean group, distinguished from *Obelus* by the simpler sculpture of the shell and the characters of genitalia mentioned above.

The name proposed by Brown in 1827, may prove to have first claim for this group, but I have not seen the original publication and it is variously spelled by the authors who have quoted it. In any case, *Turricula* must be rejected from the nomenclature of Helices, being preoccupied in Mollusca.

H. newka Dohrn, iv, 29.
H. newkopsis L. & B.
H. majoricensis D. & H., iii, 258.
H. miscella West.
H. caroni Dh., iv, 29.
  v. pyramis Phil., iv, 30.
H. elata F.-B., iv, 29.
  v. dilatata Ben.
H. trochlea Pfr., iv, 30.
H. sequentiana Ben., iv, 30.
H. terrestris Penn., iv, 29.
  elegans Gmel.
  trochulus Hartm.
H. scitula C. & J., iv, 29.
  trochilus Poir.
  depressa Bk.
  perdepressa West.
H. trochoides Poir., iv, 27.
  algira Chier.
  solarium Risso.

v. pyramidella Jan.
v. sulculata C. & J.
rugosiuscula Mich.
v. vidua West.
v. infulata Paul.
v. conica Drap.
H. turritella Parr., iv, 27.
f. remissa Parr.
H. verticillata Parr., iv, 27.
H. liebtruti Alb., iv, 28.
H. idaliæ Bgt., iv, 28.
H. pyramidata Drp., iv, 23.
agnata Zgl.
arenaria Zgl.
littoralis Zgl.
sabulosa Zgl.
spectabilis Zgl.
pyramidatoides Orb.
v. nova Paul.
v. depressa Bgt.
v. tarentina Pfr., iv, 24.
H. apiculus Rm., iv, 29.
cumiæ Calc.
H. numidica Moq., iv, 24.
v. sulliottii Poll.
H. calcarata Ben., iv, 28.
H. schembrii Scac., iv, 28.
schombrii err. orig.
H. cucullus Mts., iv, 28.
H. inops Mouss., iv, 26.

Insufficiently known species: H. crenulata Müll., H. licodiensis Cafici, H. pupilla Serv., H. eupyramis, spællina, kelibiana, spælla, zitoumica, madana, galactina, veneriana Let. & Bgt., H. tisemsinica, mactanica, capuana, dyrrachiensis Bgt., H. apiculiformis Anc., H. subnumidica (Bgt.) West., H. ogygiaca West. See also iv, p. 30.

Section *Cochlicella* Risso, 1826.

Cochlicella (Fér.) Risso, Hist. Nat. Eur., Mérid. iv, p. 77.—Martens, in Alb., Die Hel., p. 117.—*Elisma* Leach, in Turton, Man. L. and Fr.-W. Sh. Brit. Is., p. 84, 1831.—*Xeroacuta* Monts., Moll. Terr. Is. adi. Sicil., 1892, p. 25, proposed for *H. acuta, ventrosa*. For anat. see Moq.-Tand., Moll. Fr., Fischer, Journ. de Conch., 1856, p. 121, Schmidt, Stylom., p. 41, Moss & Paulden, Manchester Mic. Soc. Trans. 1892, p. 75.

Shell perforated, with elongate, turrited spire, higher than wide; opaque and white, usually streaked or banded with brown or waxen; whorls rounded, at least the last one. Aperture oval, the lip simple and acute, expanded toward the columellar insertion. Type *H. barbara* L., pl. 68, fig. 29.

Genitalia: penis of the usual form, the retractor inserted in an obliquely truncated, cylindrical calcareous body at its apex (pl. 69 fig. 21), in which the long epiphallus terminates; flagellum short. Vagina without appendages; but on the atrium there is a long organ of unknown function, either a degenerate dart sack or an "ap-

pendix" (pl. 69, figs. 19, 20, 21, *H. acuta;* fig. 21 upper part of penis outlined, through which is seen the calcareous ring in which the epiphallus ends, with attached retractor). The spermatophore (fig. 20, x 8) is very long, oval in section, chitinoid in substance, with an elevated closely serrate edge. In *ventricosa* and *conoidea* mucus glands and a small dart sack are present.

Distribution: middle and southern Europe, northern Africa, etc. *H. ventricosa* introduced into Bermuda and very abundant there.

The absence of mucus glands in *H. barbara* is remarkable, and doubtless the result of degeneration. The spermatophore is similar to that of *Leptaxis* which also has a similar boot-shaped spermatheca.

H. barbara L., iv, 32.
acuta Müll.
meridionalis Risso.
fasciatus Penn.
v. terveriana Mouss.
H. conoidea Drap., iv, 31.
fibula Wood.
turbida Küst.
solitaria Pfr.
v. calaritana Paul.
H. ventricosa Drap., iv, 32.
ventrosa Auct.
bulimoides Moq.
H. pringi Pfr., iv, 32.
H. bellucciana Bgt.
H. duplicata Mouss., iv, 31.
H. contermina Sh., iv, 31.
psammoica Morel.
H. psammæcia Bgt.
H. psammæcella Let. & Bgt.

Subgenus Theba Risso, 1826.

Theba (Leach *MS.*) Risso, Hist. Nat. Eur. Mérid. iv, p. 73, in part.—Westerlund, Fauna, p. 71, in part.—*Teba* Leach, in Turton, Man. Land and Fresh-water Sh. Brit. Is., 1831, p. 36 (in part). —*Zenobia* Gray, Lond. Med. Repos., xv, March, 1821, p. 239 (for *H. Zenobia corrugata*, undescr. and unfig., and *H. Zenobia* "*binarginata*"=*H. carthusianella* Drap.). Not *Zenobia* Oken, 1815 (Lepidoptera).—*Euomphalia* Westerlund, Fauna Paläarct Binnenoonch., *Helix*, pp. 31, 92 (1889).—*Carthusiana* Kobelt, Catalog der im Europ. Faunengebiet lebenden Binnenconchyl. p. 11, 1871.—See for anatomy, Hesse, Jahrb. D. M. Ges. 1884, p. 234, pl. 5.—Schmidt, Stylom., pl. 7.—Moq.-Tand., Moll. Fr. pl. 16.—Ashford, Journ. Conch. Leeds, iv, pl. 10.—Schuberth, Arch. Naturg-1892, pl. 2.—v. Ihering, Morphol. u. Syst., p. 440.

Shell depressed-subglobose, narrowly umbilicate or imperforate, *whitish* or banded with white, but *rather thin* and *somewhat translu-*

cent, the surface *finely malleated, shining;* last whorl wide, slightly descending. Aperture wide-lunar, but little oblique; lip acute, slightly expanded below, strengthened within by a distinct submarginal rib. Type *H. carthusiana* Müll., pl. 68, figs. 25, 26.

Jaw with numerous flat, close ribs. Marginal teeth with an abnormally large number of denticles, at least in some species. Penis short and swollen, passing into an epiphallus which ends in a short flagellum and the vas deferens; *no retractor muscle.* Mucus glands inserted high on vagina, at root of spermatheca duct, and consisting of three pairs of tubes. Far below them is a long blind sack with plicate internal walls, but *containing no dart*, evidently a degenerate dart sack. Spermatheca irregular-oblong, its duct long and branchless. Right eye retractor not passing between branches of genitalia (pl. 69, fig. 22, *H. carthusiana.* Pl. 69, fig. 16, *H. syriaca.* Pl. 69, fig. 14, *H. cantiana*). The arrangement and number of mucus glands varies in the different species.

Distribution, middle and southern Europe and Asia Minor.

The group is well distinguished by the whitish but still somewhat translucent, finely malleated shell, with conspicuous lip-rib, as well as by the lack of penis retractor muscle (cf. *Cepolis*) and the lack of a dart in the lengthened but evidently degenerate dart sack.

Risso's genus *Theba* contained ten species of several groups, but after eliminating the first three and last two, which were removed by subsequent authors to other groups, *Euparypha*, *Cochlicella*, etc., we have left five forms of the *H. carthusiana* type. Westerlund has made these the basis of *Theba;* and it seems better to follow his example rather than to legislate the group completely out of existence as we would be compelled to do were we to adopt Kobelt's name *Carthusiana*, proposed in 1871. The latter name is, moreover, objectionable from being the duplication of a specific name, although this alone would not bar its acceptance. Gray's *Zenobia* is founded upon a species of this group, but is preoccupied. It has been used hitherto in a totally incorrect manner by European writers, evidently from failure to consult the original paper in which it was proposed. Westerlund's group *Euomphalia* is founded on *H. strigella* and its allies, which are anatomically like *Theba.*

H. alphabucelliana Paul., iii, 204.
H. anconæ Iss., iii, 192.
oliviaria, Iss., *olim.*
rubella Risso.
dacampi Villa.
f. carfaniensis Stef.
v. marchetti Stef.
v. simplicita Parr., iii, 194.

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H. apennina Mühl, iii, 202.
H. arpatschaiana Mss., iii, 177.
v. pseudoglobula Mss., iii, 197.
H. berytensis Fér., iii, 194.
v. rachiodia Bgt., iii, 194.
granulata Roth.
v. fourousi Bgt., iii, 194.
H. cantiana Mont., iii, 192.
pallida Jeffr.
f. cantianiformis Bgt.
H. carthusiana Müll., iii, 195.
arenaria Oliv.
olivieri C. Pfr.
binarginata Gray.
gibsi Leach.
f. carthusianella Dr.
rufilabris Jeffr.
innoxia Bgt.
f. fasciata West.
f. leucoloma Stab.
f. claustralis Parr.
v. radiata West.
v. archimedea Ben.
v. ventiensis (B.) Fag.
v. diurna Bgt., iii, 193.
v. leptomphala Bgt.
v. encyæ Serv.
v. euscepia Serv.
v. conoidea Branc.
v. glabella Drap., iii, 186.
v. sarriensis Pena, iii, 193.
v. episema (B.) Serv.
v. lamalouensis Reyn.
taurinensis Pini.
f. arvensis Pini.
H. cemenelea Risso, iii, 193.
galloprovincialis Dup.
vars. campanica Paul, oustera Mab., monerebia, gaudefroyi, abebaia, apuana Mab., riparia Bl., ardesa, sobara, iadola Bgt., putoniana (Mab.), Loc., iii, 194, reesmanni Cless., delacuri Mab. =delacourti Mab., Bgt.
H. flaveola Kryn.
H. flavolimbata Bttg., iii, 201.
H. globula Kryn., iii, 197.
v. nana Bttg.
H. helvola Friv., iii, 202.
v. martensi West.
H. hirci Cless.
H. holotricha Bttg.
H. martensiana Tib., iii, 203.
lavata Tib.
H. mnenia West.
H. obstructa Fér., iii, 196.
obstrusa Fér.
f. dilatata West.
f. adpressula Friv.
H. olivieri Fér., iii, 191.
v. parumcincta Parr.
v. bicincta Ben.
rizzæ Arad.
v. cribrata West.
v. gregaria Zgl., iii, 196.
occulta Biv.
H. orsinii (Porro) Villa, iii, 203.
ochracea Zieg.
v. majellæ Kob.
v. picena (Tib.) Kob.
H. pachnodes Bttg.
H. pantanellii Stef.
H. parreyssi Pfr., iii, 203.
modesta Parr.
H. phæozona Mts., iii, 205.
H. pisiformis Pfr., iii, 197.
v. atypa Bttg., viii, 187.
H. rothi Pfr., iii, 197.
f. inversa West.
f. draxleri Zel.
H. rubens Mts., iii, 205.

f. concolor Mts.
f. finschiana Mts.
f. zeiliana Mts.
f. regeliana Mts.
H. rufispira Mts., iii, 204.
v. albidorsalis Mouss.
H. samsunensis Zel.
H. schotti (Zel.) Pfr.
H. schrenki Midd., iii, 200.
siberica Friv.
H. semenowi Mts.
f. depressa Mouss.
H. septemgyrata Mss., iii, 201.
H. strigella Drap., iii, 202.
sylvestris Alt.
altenana Gartn.
fruticosa Parr.
cornea Hartm.
piligera Andr.
vitrinosa Zgl.
hexagyra Mühl.
peregra Parr.
v. colliniana, lepidophora, rusinica, separica, vellavorum, ceyssoni, buxetorum, nemetuna, cussetiensis, mehadiæ, agapeta Bgt., briandi, dubreili Serv.
H. subobstructa Bgt., iii, 196.
v. distypa West.
H. suborbicularis Mts., iii, 203.
H. syriaca Ehr., iii, 197.
onychina Rm., f. 568.
H. talyschana Mts., iii, 195.
H. theobaldi West.
H. transcaspia Bttg., viii, 187.

Section *Lejeania* Ancey, 1887.

Lejeania Anc., Conchol. Exch. i, p. 75, June, 1887, types *H. darnaudi* Pfr., *isseliana* Morel., *jickeliana* Nev.—*Pella*, in part, of authors.

Shell narrowly umbilicated, depressed-globose, thin, with the texture of Fruticicola; *brown with opaque whitish bands, or opaque-white with dark bands.* Lip thin, simple, expanded toward the umbilical insertion. Type *H. darnaudi* Pfr.

Jaw high-arched, with numerous flattened, wide ribs, hardly denticulating the margin (pl. 71, fig. 43, *H. scioana*). Radula having the middle teeth tricuspid, median cusp shorter than basal-plate. Laterals bicuspid; marginals with the ectocone split (pl. 71, fig. 42, *H. scioana*).

Genital system (pl. 71, fig. 44, *H. lejeaniana*) with no retractor on penis, flagellum long. Spermatheca on a short duct. Dart sack short, swollen, inserted on atrium; mucus glands in two groups of 3 or 4 each (*lejeaniana*), or wanting apparently (*scioana*).

Distribution, Abyssinia, southern Arabia. My knowledge of the anatomy of this group is from Pollonera's work Boll. Soc. Mal. Ital. xiii, p. 75, pl. 3. *The position of the right eye-retractor is unknown.*

No penis retractor is shown in Polloneras's figures or mentioned by him, so I suppose it is absent; and it is mainly on this ground that I place the group next to *Theba*. The hairy species may belong elsewhere, but judging from the anatomy of *scioana*, they are better placed here. The shell diagnosis given above applies to the typical forms.

H. isseli Morel., iii, 105.
darnaudi Jick. part.
H. lejeaniana Bgt., iii, 104.
darnaudi Jick. part.
H. achilli Bgt., iii, 105.
H. darnaudi Pfr., iii, 104.
v. heuglini Mts., iii, 104.
H. hamacenica Raff., iii, 250.
H. subnivellina Bgt., iii, 250.
H. nivellina Bgt.
alexandrina Parr., undescr.
nivea Zgl. not Gmel.
H. leucosticta Mts., viii, 190.
H. jickelii Nev., iii, 230.
H. pilifera Mart., iii, 190.
H. combesiana Bgt., iii, 190.
pilifera Jick.
H. ferretiana Bgt., iii, 190.
H. herbini Bgt., iii, 190.
H. galinieriana Bgt., iii, 190.
H. beccarii Jick., iii, 189.
ciliata Morel.
H. scioana Poll., viii, 190.
H. d'hericourtiana B., iii, 104.
H. strigelloides Poll., viii, 190.

Section *Platytheba* Pilsbry, 1894.

Nummulina Kob., Catalog Eur. Binnenconch., p. 12, 1871. Not *Nummulina* d'Orbigny, 1826 (Polyzoa).

Shell narrowly umbilicated, depressed and *lens-shaped, acutely keeled;* thin but rather solid, costulate striate, whitish. Aperture quite oblique, transverse, and angular outside; peristome simple above, the basal lip slightly thickened within and dilated at insertion. Type *H. nummus* Ehr., pl. 68, fig. 30.

Genital system (pl. 69, fig. 17, *H. nummus*) as in *Theba*, the penis lacking retractor, flagellum very short, etc.

These are simply keeled Carthusianas, as von Ihering has already maintained, but the shell features demand recognition by name. The group is characteristic of Syria and the Caucasus region. It has no alliance with *Plectotropis*, although the shells are somewhat similar.

H. nummus Ehr., iii, 199.
hedenborgi Pfr.
oxygyra Boiss.
H. spiroxia Bgt., iii, 199.
H. promethus Bttg., iii, 199.
H. genezarethana Mouss., iii, 199.
tiberana Mouss.
H. jasonis Dub., iii, 199.

Genus HYGROMIA Risso, 1826.

=*Hygromia* Risso, 1826,+*Bradybæna* Beck, 1837 (part),+*Fruticicola* Held, 1837,+*Monacha* Fitz., 1833,+*Trichia* Hartm., 1841?+*Petasia* Beck, 1837,+*Metodonta* Mlldff., 1886, etc., etc.

Shell rather thin and subtranslucent, with little calcareous substance, brown or whitish, unicolored or with a peripheral white zone, frequently hairy. Umbilicus open or minute; form globose-depressed, with convex or conoid spire, and rounded or angular periphery. Aperture lunate, the lip acute, expanded below, usually thickened within, the basal margin rarely 1 or 2 toothed. Type *H. cinctella* (See pl. 55, figs. 20 to 30).

Jaw arched, thin, with delicate low riblets which denticulate the margins but feebly (pl. 70, figs. 31, 39). Radula as usual in ground-snails. Median cusps long and acute, the side cusps usually developed though small on middle teeth. Ectocones well developed on lateral teeth. Marginals with long simple or bifid inner and small simple or split outer cusp.

Genital system (pl. 70, figs. 30–41); penis continued in an epiphallus which bears the retractor and ends in a short flagellum and the vas deferens. Dart sack single or repeated, with or without accessory sacks, the contained dart or darts cylindrical below with short blades at apex. Mucus glands inserted on vagina above the dart sack, consisting of several independently inserted or grouped tubes. Right eye-retractor passing between branches of genitalia. Dart apparatus sometimes entirely lacking by degeneration.

Distribution, Europe, North Africa and Western Asia.

The genus is not very fully represented in the fossil series as now known, although a moderate number of forms are found extending as far down as the Oligocene of middle Europe. I do not know that any Eocene or earlier species can be referred with certainty to the group, but it is not unlikely.

The prominent features of this genus are (1) the thin dull-colored shell, in which calcareous matter is never predominent, a hairy coat is often developed, and the lip is not reflexed; (2) the thin jaw with many slight riblets; (3) the normal disposition of the right eye-retractor, the short flagellum, frequent doubling of the dart sack and the separation of mucus glands from the latter. These features separate the genus from *Helicella*, which is allied in *form* of the

shell and of the genital organs, and from *Eulota* which has a shell of much the same form and texture.

In certain forms (*H. revelata*, *H. ciliata*, and the section *Metafruticicola*) the dart sack and mucus glands are absent; but as there are other species showing the gradual steps of this loss,—first in the empty condition of the dart sacks, then their disappearance, and finally the gradual disappearance of the mucus glands also,—we are compelled to consider these simplified species as degenerate and *secondarily* simple lines of descent It is noteworthy that in shell, jaw and teeth they retain the normal structure of the genus, as well as in the structure of the penis.

The presence of these forms lacking the cardinal features of the *Belogona* might be construed by some as invalidating the premises upon which the primary groups of Helices are founded; but this would be a very short-sighted view. The facts simply show that in some members of highly organized groups, retrogressive evolution has taken place, resulting in structures similar to those characteristic of lower groups. This is a very common phenomenon in many orders of animals. In the case under discussion, the organs of mastication and the shell have undergone no changes, and the penis and its appendages retain their normal characters. Compare v. Ihering, Morphol. u. Syst., p. 450, who supports this view.

In regard to the nomenclature adopted for the group, I have simply made the changes from current usage demanded by the law of priority. It is absurd to continue to use "Fruticicola" in a generic sense when it is everywhere acknowledged that *Hygromia* is a dozen years earlier, and is properly diagnosed, etc., in a work known to and used by all systematic conchologists. *Fruticicola* is later than *Monacha* (type *incarnata*) and on a par with *Bradybœna*. The names *Zenobia*, *Petasia*, *Trochiscus*, *Latonia* and *Trichia* are clearly preoccupied, and can, therefore, have no place in the nomenclature of Helices. They have hitherto been used in ignorance of this fact, or in defiance of it.

The sectional scheme proposed below is remodelled from current European usage, except that *Theba* and allied groups have been removed to *Helicella*, as advocated by von Ihering, and the preoccupied names are dropped. The species herein referred to sections *Monacha* and *Fruticicola* require much investigation, and doubtless considerable re-arrangement, and some students may consider it best to split them into more sections. The other sectional divisions agree

in essential points with recent European authorities, and seem to be well-founded.

Section *Hygromia* Risso, *s. str.*

Shell subconic, narrowly perforated, with convex-conic spire, *keeled periphery* and convex base; horn-colored or brown, somewhat translucent, with *an opaque-white peripheral girdle.* Surface smoothish, not hairy. Aperture oblique, lip expanded below, reflexed at columellar insertion, thickened within. Type *H. cinctella*, pl. 55, figs. 20, 21.

Jaw arcuate, with many wide, flat riblets (pl. 70, fig. 39, *H. cinctella*). Genitalia (pl. 70, fig. 32 *H. limbata*), having the epiphallus long, flagellum very small. Four mucus tubes on each side, and below them one small dart sack containing a dart. Duct of spermatheca long.

Species few, confined to southern-central Europe.

H. cinctella Dr., iii, 186
? ranzani Orsini.
f. fasciata Paul.
f. chelydea West.
H. tassyi Bgt.
H. limbata Dr., iii, 189.
f. sublimbata Bgt.
f. odeca Bgt.
f. hylonomia Bgt.
v. delomphala Anc.

Section *Monacha* Fitzinger, 1833.

Monacha Fitz., *l. c.*, for *incarnata* only.—Not *Monachus* Kaup, 1829 (Aves).—*Latonia* Westerlund (in part), Fauna Paläarct. Binnenconch., *Helix*, pp. 30, 68. Not *Latonia* Mey., 1843 (Reptilia), nor *Latona* Schum. 1817 (Moll.) nor of Strauss, 1817 (Crust.).

Shell covered-perforate or narrowly umbilicated, depressed-subglobose with 6–7 whorls, the last rounded or subangular; surface minutely scaly or hairy. Aperture oblique, widely sublunate, lip expanded, well thickened within. Type *H. incarnata* Müll., pl. 55, figs. 29, 30.

Genitalia (pl. 70, fig. 34 *H. incarnata*) as in *Hygromia* s. str; penis as usual in the genus; 4 or 5 mucus tubes on each side; dart sack single.

This group is purely conventional, and is retained to contain a series of species distributed by some authors in *Eulota, Carthusiana* and *Latonia.* Part of the Fruticicolas have the same anatomical features. See v. Ihering, Morphol. u. Syst. Helix, p. 449, and the authorities there cited, for characters the soft parts.

H. acorta L. & B.
H. andria Mts., viii, 186.
H. aristata Kryn., iii, 201.
H. bidinensis Caf., iii, 189.
v. daphnica Platania.
f. flavida Plat.
H. bifaria West.
H. brigantina Meng., iii, 204.
H. caidis Anc.
H. capusi Villes.
H. carascaloides Bgt., iii, 193.
H. catoleia Bgt.
H. cheffiana Bgt.
H. circassica Mss., iii, 195.
colchica Bayer.
H. consona Zgl., iii, 188.
f. panda West.
H. cruzyi Bgt., iii, 198.
H. dasilepida Bgt.
H. densecostulata Ret.
H. euages Bttg., iii, 201.
f. depressa Bttg.
H. euboeica Kob.
H. faidherbiana Bgt., iii, 189.
H. frequens Mouss., iii, 193.
v. obscura Mouss.
H. freytagi Malz.
H. fruticola Kryn., iii, 200.
v. bourguignati Pfr.
H. grelloisi Bgt.
H. hausknechti Bttg., iii, 193.
H. hiberna Ben., iii, 188.
H. incarnata Müll., iii, 187.
sylvestris Hartm.
rubra Chier.
f. pallidula Moq., veprium [Bgt., silanica Bgt.
v. tecta Zgl., iii, 187.
obtecta West.
v. monodon Villa, iii, 188.
armata Stab.
v. welebitana St.
v. byssina Gredl.
v. juriniana Bgt., iii, 188.
H. inchoata Morel., iii, 200.
H. lenabarica Let.
H. lepidolena Bgt.
H. lurida Zgl.
H. messenica Bl. & W.
v. acaica West.
H. musicola Bgt.
H. nicaisiana Let.
H. nicosiana Mss., iii, 189.
f. pallida Mouss.
H. ovularis Bgt.
H. pirajnea Ben., iii, 192.
H. prærupta West.
H. proclivis Mts., viii, 187.
H. pseudosericea Ben., iii, 196.
H. redtenbacheri Zel., iii, 189.
H. rissoana Pfr., iii, 195.
v. dirphica Blanc., iii, 192.
v. langei Bgt.
H. rusicadensis Let., viii, 188.
H. schuberti Roth, iii, 195.
v. frutis Parr.
H. semirugosa Kob., viii, 188.
H. vicina Rm., iii, 188.
carpatica Friv.
H. villæ Desh., iii, 198.
H. zonitomæa Let., viii, 189.

Section *Fruticicola* Held., 1837 (restricted).

Fruticicola Held, Isis, 1837, p. 914 (in part).—v. Mart., Die Hel., 1860, p. 103, type *H. hispida*. Not *Fruticicola* MacGill.,

1839 (Aves).—"*Fruticola*" of some writers.—*Bradybæna* Beck, Index Moll. 1837, p. 18. Not *Bradybænus* Dej., 1829 (Coleoptera). —*Trichia* Hartmann Erd- und Süsswasser-Moll. Schweiz, p. 41 (for *H. hispida*, etc.). Not *Trichia* de Haan, Fauna Japonica, Crustacea, p. 109 (1840!).

Shell depressed, with convex spire, rounded periphery, and open or narrow umbilicus; brown or greenish, the surface generally hairy. Aperture lunate, slightly oblique, the ends of the thin lip approaching; peristome simple, expanded only at the columellar insertion, and with only a weak internal thickening or none. Type *H. hispida* L., pl. 55, figs. 27, 28.

Jaw delicate, with 10–18 low riblets. Genital system (pl. 70, fig. 33, *H. hispida*); penis as usual in the genus; mucus glands several; two dart sacks, each with an accessory sack.

Hartmann's name *Trichia* has been used for this group, but its date is uncertain (his book having appeared in parts, from 1840 to 1844), while *Trichia* de Haan is known to bear date 1840. Moreover it seems best to use Held's earlier term *Fruticicola*, which is well known to all malacologists.

The species are very numerous throughout the European area, and several have been imported by commerce into America, etc. A few Chinese species of unknown anatomy are best referred here until their true position can be ascertained.

H. aclerochroa Bgt., iii. 181.
H. alsia Bgt., iii, 177.
H. becasis Ramb., iii, 176.
H. bourniana Bgt.
H. cælata Stud., iii, 175.
  v. cœlomphala Loc.
  v. vagienna Poll.
  v. cælatina Loc.
H. cedretorum Deb., iii, 179.
H. chnoodia Bgt., iii, 179.
H. chonomphala Bgt.
  ripularum Lessona.
H. chrysotricha Bttg., viii, 190.
H. clandestina Hartm., iii, 175.
  gratianopolitana Ramb., iii, 175.
  v. isarica Loc.
H. clessini Ulic.
H. corsica Sh., iii, 180.
H. crispulata Mouss.
H. cynetarum Malz.
H. dieckmanni Mss., iii, 179.
H. dussertiana Bgt., iii, 177.
H. erjaveci Brus.
  f. mortella, tanora, avarica, savinella Serv.
H. filicina Schm., iii, 176.
  v. nudata West.
H. fusca Mont., iii, 186.
  corrugata Gray.
  subrufescens Mill.
H. granulata Alder, iii, 178.
  globularis Jeffr.

H. hispida L., iii, 172.
prevostiana Risso.
v. gyrata West., iii, 173.
v. concinna Jeffr., iii, 173.
v. nebulata Mke.
v. septentrionalis Cl.
v. depilata Ald.
v. conica Jeffr.
v. hemisphærica Less.
v. beaudouini Loc.
v. laticensis Loc.
v. morchii West.
v. hispidosa Mouss., iii, 172.
v. nana Jeffr., iii, 173.
H. kusmici Cless.
H. langsdorffi Mill.
H. lanuginosa Boiss., iii, 180.
flava Terver.
H. lasia Bgt., iii, 179.
H. latiniacensis Loc.
H. martorelli Bgt., iii, 179.
H. matronica Mab.
H. melaspinæ Bgt., iii, 180.
H. mendicaria Pfr.
H. mesoleuca Mts.
H. mongrandiana Bgt.
H. montana Stud., iii, 175.
circinnata Stud.
erecta Hartm.
v. dubisiana Cout.
v. danubialis Cless.
H. montivaga West.
salmurina Serv., iii, 181.
H. moquiniana Raym., iii, 181.
f. fradiniana Bgt.
H. multigranosa Mouss., iv, 36.
H. nordenskiöldi W., iii, 201.
rufescens Schrenk.
H. parlatoris Biv., iii, 179.
H. perlevis Sh., iii, 181.
H. plebeia Drap., iii, 174.
f. plebicola Loc.
H. ponsonbyana Pils., viii, 190.
ponsonbyi West. not Kob.
H. psaturochæta Bgt., iii, 182.
H. ptylota Bgt., iii, 181.
H. reinæ Ben., iii, 187.
H. revelata Fér., iii, 180.
ponentina Dup.
martigena Fér.
f. conimbricensis Silv., venetorum Bgt., nevesiana Silv., villula Bgt., platylasia Bgt.
v. occidentalis Recl., iii, 180.
lisbonensis Pfr.
H. roseotincta Fbs.
H. rubiginosa Schm., iii, 178.
v. epirotica Mouss.
H. rufescens Penn., iii, 175.
f. depressa Tayl., minor Jeffr., rubens Moq., albocincta Ckll., alba Moq., manchesteriensis Bgt., brittanica West.
v. striolata C. Pfr.
f. subcarinata Cless.
f. abludens Loc.
v. submontana Mab.
pascali Mab.
v. putoni Cless.
H. saxivaga Malz.
H. sericea Drap., iii, 178.
f. gerstfeldiana Cless., plana Mil., caucasica Mouss., fontainei Colb.
v. expansa Cless.
v. corneola Cless.
v. dubia Cless.
v. libertina West.
v. badiella Zgl., Bgt.
v. subbadiella Bgt.
v. subglobosa Jeffr.

H. sordulenta Morel., iii, 177.
H. stuxbergi West.
sericea Schrenk.
H. subcælata Less., iii, 173.
v. hiaticula West.
H. subplebeia Less., iii, 173.
H. telonensis Mitt., iii, 186.
f. lavandulæ Bgt., druentina Bgt., diæga Bgt., gelida Bgt., concreta Bgt., crimoda Bgt., pedemontana Pini, salassia Poll., pegorarii Poll., segusina Less., iii, 179.
v. crassilabris Nev.
v. moutoni Mitt., iii, 186.
H. teneitensis Bgt., iii, 180.
H. transsylvanica Blz.
H. umbrosa Partsch, iii, 176.
v. aporata Bgt.
v. umbrosella Jouss.
v. sciraia Bgt.
v. oecoscia Bgt.
v. amella Bgt.
H. urbana Cout.
H. vespertina Morel., iv, 41.
H. villersii Malz., iii, 173.
H. villosa Stud., iii, 177.
hispidula Jan.
pilosa Alten.
f. detrita Hartm.
v. phorochætia Bgt.
H. villosula Zgl., iii, 176.
pietruskyana Parr., iii, 176.

Oriental species.

H. submissa Dh., iii, 182.
H. subechinata Dh., iii, 182.
H. szechenyii Anc.
H. tchefouensis C. & D., iii, 182.
munieriana C. & D.
H. puberula Hde., iii, 183.
H. horripilosella Hde., iii, 183.
H. nautarum Hde., iii, 183.
H. rebellis Hde., iii, 183.
H. barbosella Hde.

Unfigured and insufficiently known species:—H. hypsellina Loc., steneligma Bgt., microgyra Bgt., hispidella Bgt., deobrigana Bgt., ataxiaca Fag., vendeana Let., bellovacina Mab., gosseni Mab., elaverana Bgt., cavarella Serv., duesmensis Loc., saporosa Mab., astenia Mab., ferdinandi Serv., bofilliana Fag., alphæa Let., anasina Serv., rosai Silv., cularensis Bgt., sarinica Bgt., tumescens West., vendoperanensis Bgt., vocontiana Bgt., axonana Mab., sericella Serv., bavariana West., aporina Silva, ischnia Mab., euclastolena Mab., berbruggeriana Loc., baccueti Bgt., challameliana Bgt., bastidiana Bgt., cotinophila Bgt., tæniata West., inversa West., hierocontina West., lentiaca Sayn (see viii, 190).

Section *Ciliella* Mousson, 1872.

Ciliella Mouss., Rév. Faun. Mal. Canaries, p. 60 (for *H. ciliata, leprosa, lanosa*).—*Lepinota* Westerlund, Fauna Palaärct. Reg. Binnenconch., Helix, 1889, p. 2, 16, type *H. ciliata.* Not *Lepinotus* Heyd., 1850, (Neuroptera).

Shell narrowly umbilicate, subdepressed, keeled or angular at periphery, thin and brownish; surface sculptured with short, scale-like cuticular processes; aperture oblique, oval; outer and basal lips well expanded, somewhat thickened within. Type *H. ciliata* Ven., pl. 55, figs. 22, 23, 24.

Animal having the mantle blotched with black as usual in the genus.

Jaw arched, transparent and yellowish, with numerous, fine, close, regular but not well defined riblets, hardly crenulating the margins (*H. ciliata*). Genital system (pl. 70, fig. 30, *H. ciliata*) with short, stout penis, its retractor terminal and with bifid insertion; epiphallus ending in a short, stumpy flagellum. Duct of spermatheca moderately short, swollen at base. Dart sack and mucus glands wanting.

Distribution, south-central Europe, Canary Islands.

H. ciliata Ven., iii, 187.
folliculata Risso.
hirsuta Jan.
v. biformis Beck.
H. guevarriana Bgt.
H. stussineri Bttg.
H. leprosa Shutt., iii, 223.
H. lanosa Mouss., iii, 223.

Section *Metafruticicola* v. Ihering.

Pseudocampylæa Hesse, Jahrb. D. M. Ges. 1884, p. 237, (*q. v.* for anatomy); Tryon, Manual of Conch. (2), iv, p. 114 (part), and of other authors. Not *Pseudocampylæa* Pfeiffer, Mal. Bl., xxiv, p. 8, 1877.—*Cressa* Westerlund, Fauna Palaärct. Reg. Binnen-Conch., *Helix*, p. 4, 101, 1889. Not *Cressa* Böck, 1871 (*Amphipoda*).—*Metafruticicola* Iher., Zeitschr. f. Wissensch. Zool. liv, p. 452 (Oct. 4, 1892).

Shell moderately solid, opaque, rather small, depressed-globose, umbilicated, with convex spire of nearly 5 whorls, the first one smooth or costulate, the remainder granulate, grano-costulate or spirally decussated, often with hairs standing in oblique series. Last whorl rounded at periphery, descending in front. Aperture subcircular or oval; peristome sharp-edged, slightly expanded below, strengthened by a strong submarginal internal rib. Type *H. pellita* Fér.

Mantle flecked with dark. Right eye retractor passing between branches of genitalia. Jaw with many (15 to 20) fine vertical riblets (pl. 70, fig. 31, *H. pellita*).

Genitalia (pl. 70, fig. 37, *H. noverca*); penis short and stout, continued in a long epiphallus bearing the retractor, and ending in a long flagellum. Spermatheca oval on a moderately long, unbranched duct, which is decidedly swollen or enlarged toward its insertion low on vagina. Dart sack and mucous glands wanting.

The shell has much the aspect of a *Helicigona* of the *cyclolabris* group, but the lip is less expanded and more thickened within, as in *Theba*. The group is doubtless correctly placed by Hesse and v. Ihering, who consider it a Fruticicoloid with the dart apparatus lost by degeneration. The jaw and other anatomy as far as known, as well as the structure of the shell, all point to this solution of the simple genitalia. It will be noticed that in *Metafruticicola* the loss of the dart apparatus has left exactly the type of genitalia found in the group Epiphallogona (*Camœna, Chloritis, Planispira*, etc.). No jaw of the delicate Fruticicola type has been found in the Epiphallogona.

Distribution, Grecian Archipelago, most species from Crete.

H. pellita Fér., iv, 115.
v. kreglingeri Zel.
v. graphicotera Bgt.
H. testacea Mart., viii, 191.
H. dictæa Mart., viii, 191.
H. naxiana Fér., iv, 115.
H. westerlundi Bl., iv, 115.
H. noverca Friv., iv, 115.
H. lecta Fér., viii, 191.
H. sublecta Malz., iv, 116.
H. zonella Pfr., iv, 110.
not the figs. cited.
H. medea West., viii, 192.
H. giurica Bttg., viii, 192.
H. cerigottana Bttg., Nachr. '94, 6.

Section *Perforatella* Schlüter, 1838.

Perforatella Schluter, Syst. Verz., 1838.—*Petasina* Morch, Catal. Yoldi, 1852, p. 6 (for *edentula* Drap.).

Shell *low-trochoidal*, with rounded-conic raised spire, subangular periphery and small or minute umbilicus. Whorls numerous and *narrowly coiled*. Brownish, often with a light peripheral band. Aperture basal, narrow; basal lip expanded, *thickened within by a very strong callus, which is usually more or less truncate or* 1-*toothed*. Type *H. unidentata* Drap.

Jaw thin, horn-colored, with 18–25 riblets (*leucozona*). Genitalia (pl. 70, fig. 36, *H. leucozona*) as in typical *Fruticicola*. The mucus

glands are inserted very high, four on each side; some distance below them are two dart sacks, with two accessory sacks, the latter containing no darts. Penis, etc., as usual in the genus. The genital system of *H. unidentata* is the same as in *leucozona*.

A group of Middle Europe, in which the shell has much similarity to *Dibothrion*, but the genitalia are as in *Fruticicola hispida*, etc.

H. unidentata Drap., iii, 171.
cobresiana Alt., iii, 171.
monodon Fér.
villæ Mühlf.
ventricosa Jan.
f. anodonta Tschap.
f. alpestris Cl.
f. subleucozona Fag.
H. edentula Drap., iii, 171.
depilata Drap.
liminifera Held.
H. leucozona Zgl., iii, 171.
coadunata Z.
f. delopida Jan.
f. crassilabris Mühlf.
f. rutilans Z.
modesta Parr.
v. ovirensis Rm., iii, 172.
v. heteromorpha W., iii, 172.
v. erjaveci Cless., iii, 172.
H. bielzi Schm.
v. bosnensis Mlldff.

Section *Dibothrion* Pfr., 1855.

Petasia Beck, Index, 1837, p. 21. Martens, Die Hel., 1860, p. 102, type *H. bidens*. Not *Petasia* Serv., 1821 (Orthoptera) of Steph., 1829, (Lepidoptera) or of Morr. 1829, (Polyzoa).—*Trochiscus* Held, Isis, 1837, p. 915. Not *Trochiscus* Heyden 1826, (Arachnida).—*Dibothrion* Pfr., Mal. Bl. 1855, p. 128 (for *bidens* and *bicallosa*).

Shell subtrochoidal, with convex-subconic spire of numerous *narrow whorls*, and closed or nearly closed umbilicus; arcuate-striate, translucent brown with light peripheral band. Aperture basal, narrow; lip well expanded, reflexed, with two strong internal teeth or nodules on the basal margin, marked by pits behind the lip; parietal wall toothless. Type *H. bidens*, pl. 55, figs. 25, 26.

Genitalia (pl. 70, fig. 41, *H. bidens*): Dart sack single, cylindrical and rather large; two mucus glands on each side. Other organs as in *Hygromia* generally, except that the spermatheca duct is unusually short. Dart needle-like, with four short blades at the point.

Distribution, eastern Europe and Siberia.

H. bidens Chemn., iii, 170.
bidentata Gm.
v. diodon Parr., iii, 171.
dibothrion Friv.

H. bicallosa Friv., iii, 171.

Section *Metodontia* Möllendorff, 1886.

Metodontia Mlldff., Jahrb. D. M. Ges., 1886, p. 191, type *H. hemipleuris*.—*Tetrodontina* Ancey, Conch. Exch. i, p. 64, May, 1887.—See Hilber, Sitzungsber. k. Akad. Wissensch., lxxxvi, pl. 1, f. 1–3, development of aperture armature.

Shell perforate, globose-turbinate or subdepressed, brown or whitish; whorls numerous and narrow, the last not descending in front. Aperture lunate, nearly closed by two large lip teeth usually situated on a ridge of callus, opposed to two smaller teeth on the parietal wall. Lip thin-edged, expanded below, reflexed at columellar insertion. Type *H. hemipleuris* Mlldff.

Anatomy unknown. The group seems most nearly allied to *Dibothrion* of the Eur.-Asian fauna. It has nothing to do with the American group *Triodopsis*.

The group is confined to the dry northern half of China, being about coextensive with the Löss formation.

H. hemipleuris Möll., iii, 149.
moltneri Gredl.
H. yantaiensis C. & D., iii, 149.
v. tetrodon Möll., iii, 149.

H. houaiensis Cr., iii, 149.
obstructa Hde. not Fér.

Genus AULACOSPIRA Möllendorff, 1890.

Aulacospira Mlldff., Bericht über die Senckenbergische naturforschende Gesellschaft in Frankfurt a. M., 1890, p. 224.—*Micropetasus* Mlldff., *l. c.*

Shell small, umbilicate, of thin corneous structure; unicolored, pale brown. Spire more or less raised, from the beginning subscalar and keeled; whorls 4 to 5, striatulate, flattened or with spiral concavity, the last whorl keeled or rounded. Aperture oblique, generally subcircular, with 0 to 5 teeth a short distance within; peristome thin, reflexed. Type *A. scalatella* Mlldff., pl. 64, figs. 10, 11, 12.

Anatomy unknown. The species live in clefts and crevices of limestone rocks, in which the flatness of their shells allows them ready access, and like *Vallonia* they seem to be gregarious. The species now known are from Cebu, Busuanga, Luzon and the Island Ilin, near Mindoro; but it probably will prove to have many more species in other islands of the Philippine group.

In deference to the opinion of Möllendorff I give the group place here in the vicinity of *Fruticicola;* but my own course would be to place it next to *Eulota* or even as a subgenus within that genus. Compare the similar group *Platypetasus* (p. 207). I am now disposed to consider *Pupisoma* (see p. 52), as well as *Aulacospira*, as branches of the *Eulota* stock, *parallel to*, rather than *allied to* Acanthinula and Vallonia which seem to be early branches of the *Hygromia* phylum. They will probably be found to have the genitalia considerably simplified by suppression of accessory organs, and the marginal teeth multicuspid; these changes usually accompanying such great reduction in the size of snails.

Möllendorff establishes two sections:

Aulacospira s. str. (of which *Micropetasus* is an absolute synonym). Keel extending to aperture; peristome continuous and free.

Pseudostreptaxis Mlldff. (*l. c.* p. 225). Penultimate whorl distinctly deviating; the last whorl not keeled, cylindrical; aperture 5-toothed, the peristome not continuous. One species *A. azpeitiæ.*

A. hololoma Mlldff., viii, 198.
A. mucronata Mlldff., viii, 198.
A. scalatella Mlldff., viii, 199.
A. porrecta Quadr. & Mlldff., Nachrbl. 1894, p. 95.
A. azpeitiæ Hid., viii, 199.

Genus ACANTHINULA Beck, 1846.

Acanthinula Beck, Amtl. Ber. Vers. Kiel, 1846, p. 122.—v. Mart. in Die Hel., 1860, p. 100.—*Euacanthinula* West., Fauna, p. 16.

Shell *minute, pyramidal or globosely-turbinate, thin*, brown, minutely umbilicated. *Epidermis raised into lamellæ* crossing the whorls. Aperture subvertical, semilunar or subcircular, the lip acute, expanded toward columellar insertion, *the margins remote.* Type *A. aculeata* Müll., pl. 70, figs. 26, 27, 28.

Animal apparently with even, not crenulated foot-margins; oviparous? Jaw arched, with numerous flat ribs. Genitalia (pl. 63,

fig. 11, *A. lamellata*, after Lehmann) apparently lacking mucus glands, but dart sack present.

Distribution, Palæarctic and Nearctic regions, mainly northward.

The genitalia are very imperfectly known, the figure in Lehmann's posthumous work representing *A. aculeata* being very much like a *Buliminus* or *Pupa*, and possibly, as v. Ihering suspects, inserted through some confusion of drawings. A new investigation is urgently required. Possibly the group does not belong to the Helicidæ. *A. lamellata* and *aculeata* have been found in Pliocene deposits; and in the lower Miocene of middle Europe the genus is represented by several species, *A. nana* A. Braun, *paludiniformis* Br., *tuchoricensis* Klika, *plicatella* Reuss.

A. aculeata Müll., iii, 53.
spinulosa Lightf.
granatelli Biv.
delectabilis Sol.
f. albida Jeffr., iii, 53.
albina West.
v. sublævis West., iii, 54.
A. spermatia Silva.
A. harpula Reinh.
A. lamellata Jeffr., iii, 54.
scarburgensis Alder.
seminulum Rossm.
A. peracanthoda Bgt., iii, 54.
raffrayi Bgt. not Canef.
raffrayana Ckll.
A. spinifera Mouss., iii, 54.
A. monas Morel., iii, 54.

Section *Zoögenites* Morse, 1864.

Zoögenites Morse, Terr. Pulm. Maine, p. 32, pl. 1.

Shell globose-turbinate, perforate, ornamented with oblique cuticular lamellæ. Type *Z. harpa* Say, pl. 70, figs. 23, 24, 25.

Animal with the foot-edges prominently crenulated; labial lobes large; lower tentacles nearly obsolete; viviparous, the young at birth as large as the aperture of the shell. Jaw (pl. 70, fig. 35) having numerous wide subobsolete ribs. Radula with formula 11.6.1.6.11. Middle teeth tricuspid, the mesocone not reaching edge of the square basal plate. Laterals bicuspid. Marginals wide, with many irregular cusps. Genitalia unknown.

A. harpa Say, iii, 54. New England, British America, Sweden, Kamtchatka, etc.

Syn.: *P. costulata* Mich., *H. amurensis* Gerstt.

Genus VALLONIA Risso, 1826.

Vallonia Risso, Hist. Nat. Eur. Mérid. iv, p. 101, sole species *V. rosalia.*—*Zurama* Leach in Turton's Man. L. and Frw. Sh. Brit. Is., p. 64, 1831.—*Amplexus* Brown, Ill. Conch. G. B. 1827; Edit. 1844, p. 45.—*Chilostoma* Fitz., in part, 1833.—*Circinaria* Beck, Index (in part), p. 23.—*Glaphyra* Alb., Die Hel., 1850, p. 87 (in part).—*Lucena* Moq.-Tand., Moll. Fr. ii, p. 140, not Oken.—See Sterki, Proc. Acad. Nat. Sci., Phila., 1893, p. 234 (monograph of genus, jaws and dentition).—Ashford, Journ. of Conch. iv, p. 198 (dart).—Lehmann, Die lebenden Schnecken u. Muscheln Stettins u. Pommern, p. 90, pl. 11, f. 30 (genitalia, etc.).

Shell *minute, openly and widely umbilicate, depressed,* the spire low-convex, consisting of 3–4½ whorls, color light and uniform; surface smooth or ribbed; periphery rounded; last whorl usually descending in front. Aperture oblique, circular or short-oval; *peristome continuous or nearly so, expanded or reflexed,* often thickened within. Type *V. pulchella* Müll., pl. 55, figs. 31, 32.

Foot small, short, with no pedal grooves; edges of sole somewhat crenulated; sole undivided; eye-peduncles cylindrical, not enlarged distally; tentacles short; labial lobes well developed.

Jaw arcuate, with a slight median projection or none, sculptured with numerous (18 to 25) crowded, low riblets, denticulating the margins (pl. 70, fig. 29, *V. pulchella*).

Radula having 23 to 33 teeth in a transverse row. *Median teeth decidedly narrower than laterals,* tricuspid, the *mesocone not half as long as basal-plate,* side cusps smaller. Laterals with large square basal plates, the mesocone extending to its edge, ectocone small. Marginal teeth wide and low, multicuspid (pl. 70, fig 38 *V. pulchella*).

Genitalia (pl. 63, figs. 9, 10, *V. pulchella,* after Lehmann) having the penis short, with terminal retractor; epiphallus short, bearing a flagellum. Dart sack present, single, containing a straight, bladeless dart (fig. 10, x 100). No mucus glands. Duct of spermatheca long, branchless.

Distribution, North America South to Texas; Japan and middle China to Europe and Atlantic Islands. Fossil the group is known from the lower Eocene (*V. sparnacensis* Dh.); and in the Miocene several species, *lepida* Reuss., *subpulchella* Sandb., occur.

This very distinct genus of minute snails occupies the entire Nearctic and Palæarctic regions, and some species have been introduced (probably with plants) into Australia, Mauritius, etc. They are gregarious in habit, and live under fragments of wood, stones, on mossy cliffs and in damp meadows, always avoiding light. The number of species is very uncertain; but whether species or varieties, there can be no doubt that a considerable number of recognizable forms must be distinguished. The arrangement given below is that of Dr. Sterki, who has made special studies on a far greater mass of material than any other observer. An alternative to this classification would be to make *excentrica* a variety of *pulchella*, and unite *adela*, *declivis* and *pollinensis* under the former of the three names; all the forms of the *costata* group might then fall under *costata* as varieties. Having seen neither *mionecton*, *ladacensis* nor *asiatica* I do not care to suggest any mode of uniting the forms included in Sterki's "Group of *V. cyclophorella*."

Group of V. pulchella.

V. pulchella Müll., viii, 248.
rosalia Risso (part).
paludosa Da Costa.
crystallina Dillw.
lævigata Moq.
nitidula Stud.
potua Chier.
minuta Say.
v. enniensis Gredl.
v. hispanica Sterki.
v. persica Rosen.
V. excentrica Sterki, viii, 249.
V. adela West., viii, 251.
V. declivis Sterki, viii, 251.
v. altilis Sterki.
V. pollinensis Paul., viii, 252.

Group of V. costata.

V. costata Müll., viii, 252.
alexandræ Cox.
rosalia Risso (pt.).
crenella Mont.
helicinus Lightf.
v. helvetica Sterki.
v. amurensis Sterki.
v. pyrenaica Sterki.
v. montana Sterki.
V. albula Sterki.
V. parvula Sterki, viii, 254.
V. tenera Reinh., viii, 255.
pulchellula Hde.
v. patens Reinh., viii, 257.
V. gracilicosta Reinh., viii, 256.

Group of V. cyclophorella.

V. cyclophorella Anc., viii, 259.
V. perspectiva Sterki, viii, 257.
V. tenuilabris Br., viii, 258.
v. saxoniana Sterki, viii, 259.
V. mionecton Bttg., viii, 260.
v. schamhalensis Rosen.
V. ladacensis Nev., viii, 260.
v. asiatica Nev., viii, 260.

Genus HELICODONTA Férussac, 1819.

Helicodonta Fer. Tabl. Syst. de la Fam. des Limaçons, p. 33 (in part).—Risso Hist. Nat. de l'Eur. Mérid., iv, p. 65, 1826 (restricted to *H. obvoluta*).—*Trigonostoma* Fitzinger, Syst. Verzeich., 1833, p. 97, species *H. holosericeum*, *H. obvolutum*. Not *Trigonostoma* Blainv., 1825, *Cancellariidæ*.—*Vortex* Beck, Index Moll., 1837, p. 29.—*Gonostoma* Held, Isis, 1837, p. 915 (preoccupied by Rafinesque in Pisces, 1810.)—*Anchistoma* ("Klein," preLinnæan) H. & A. Adams, Gen. Rec. Moll. ii, p. 205, 1855 (subg. *Polygyra* and *Drepanostoma* only, the former in part).—*Euphemia* Leach, *teste* Beck, Amtl. Ber. v. Kiel, 1846, p. 122.—? *Plicostoma* Schluter, Verz. p. 4, 1838, s.-g. *Helix*, for *H. intestinalis* Schlüt. (publication not seen by H. P.).—*Chilodon* and *Helicodon* Ehrenb. Symb. Phys., 1831.

Drepanostoma Porro, Mag. de Zool., 1836, classe v, pl. 71, type *D. nautiliformis*.—*Contorta* Meg. de Muhlf., *test.* Villa, Disp. Syst. Conch. Coll. Villa, p. 19, 1841.

Caracollina Beck, Index Moll., p. 28, 1837.—Lowe, P. Z. S., 1854, p. 196, type *H. barbula* Charp.—And probably *Caracollina* Ehrenberg, Symb. Phys. Evert., Moll., no diagnosis; no species mentioned.—*Caracolina* auct.

Aspasita Westerlund, Fauna der in der Paläarctischen Region Lebenden Binnenconchyl., Helix, pp. 18, 26, type *H. triaria*.

See for anatomy, A. Schmidt, Stylommatophoren p. 34, pl. 8. Moq.-Tand, Hist. Nat. Moll. France, p. 109–114, pl. 10.—Hesse, Jahrb. d. d. Malak. Ges. xi, 1884, p. 233, pl. 4, f. 5.—St. Simon, Journ. de Conch., 1867, p. 98.—Schuberth, Archiv f. Naturg., 1892, p. 5, pl. 1.—v. Ihering, Morphol. u. Syst., p. 475.

Shell *depressed, usually umbilicated*, rather thin, never cretaceous; *unicolored brown;* striate, granulate, ribbed or hairy. Spire low, consisting of numerous closely coiled whorls. Aperture triangular, rhombic or lunate, the lip-ends remote; *peristome expanded and reflexed*, lipped, often toothed. Type *H. obvoluta*, pl. 56, figs. 25,

26, 27 (see also pl. 56, figs. 16, 17, *H. constricta;* figs. 18, 19, *H. lens;* figs. 23, 24, *H. triaria*; figs. 28, 29, 30, *H. biconcava;* figs. 31, 32, 33, *H. nautiliformis*).

Animal rather elongated, with long, narrow foot, the sole undivided; back with a pair of longitudinal grooves; facial grooves wanting. Mantle with a small right body-lappet; no left one. Right eye-retractor passing between branches of genital system. Epiphragm papery, flat, formed rather deep in the mouth.

Jaw thin and flexible, with numerous (6 to 16) broad, flat ribs, separated by narrow interstices (pl. 36, fig. 6, *H. lenticula;* pl. 36, fig. 8, *H. maroccana*).

Radula having the mesocones slightly longer than the basal plates, ectocones small. Marginal teeth having the ento- and mesocones united at base, ectocone developed (pl. 36, fig. 5, *H. lenticula.* Pl. 36, fig. 7, *H. maroccana*).

Genital system: penis long, the retractor median or terminal, *inserted distally on columellar muscle; no flagellum.* Vagina long, bearing from one to three cylindrical elongated mucus glands, with one dart sack at or below their base, sometimes lacking; the dart, when present, short and conical (pl. 36, fig. 9, *H. lusitanica*). Spermatheca oval, its duct short, bound to the uterus and without diverticulum. See pl. 36, fig. 4, *H. obvoluta;* pl. 36, fig. 10, *H. lusitanica.*

The number of mucus glands varies from one to three. *H. obvoluta* has one long and one very short gland. The dart sack is entirely absent in some species. The dentition is of the type usually developed in ground snails. The jaw is uncommonly delicate for the ribbed type. The union of the penis retractor muscle with the great columellar retractor is a peculiar feature, and it will be interesting to find whether it holds throughout the genus. I have observed it in *H. obvoluta* only.

The brownish, unicolored shell, with depressed spire, slowly widening narrow whorls and reflexed, lipped peristome, is very characteristic; and no shells of the Palæarctic fauna, except *Isognomostoma* and *Dibothrion* can be compared with this genus—these two groups also having toothed apertures, but sufficiently different in form from those of *Helicodonta.*

Von Ihering maintains, I believe with right, that this genus is more nearly allied to *Fruticicola* than to *Helix* or *Campylæa*, differ-

ing mainly in the reflexed, lipped peristome, and more or less degenerate dart apparatus. *Helicodonta* is not in the least allied to the American or Indian toothed Helices, or to the so-called *Gonostoma* of California.

The circum-Mediterranean region is the headquarters of this genus, although a few forms occupy central Europe, and one, *obvoluta*, has obtained a foothold in southern England. In south-east Asia it reappears in a number of specific forms comparable to the European species *obvoluta* and *diodonta*, but not readily falling into the sectional groups established for European forms. The Canary Islands are nearly the westward outpost of the genus, one species only occurring in Madeira.

The name *Helicodonta* was originally proposed for all toothed Helices ; but was restricted by Risso, in 1826, to *H. obvoluta*. As no other name for the group appeared before 1833, there is no question as to the propriety of reverting to this one, especially since the names in common use, *Gonostoma* and *Trigonostoma* are preoccupied, and must, in any case, be rejected. Besides two species still retained in this group, Férussac included in *Helicodonta* members of the prior genera *Polygyra*, *Pleurodonte*, *Cepolis*, and *Anostoma*, as well as of the later groups *Strobila*, *Corilla* and *Petasia*. The term *Anchistoma* of the Adam's brothers (1855) has been used for *Helicodonta* by Kobelt and others. It has been attributed to Klein (1753), but his "*Angystoma*" contains none of the European toothed Helices and, in any case, the genera and species of the *Tentamen methodi Ostracologicæ* are not of Linnæan form, and antedate the Linnæan era. Ehrenberg's contribution to the taxonomy of this group is of little value. He divides the land snails into two series, based on the absence or presence of aperture-teeth : *Chilogymnus* containing Helix, Caracolla, Bulimus, Pupa, and *Chilodon* containing Helicodon, Caracollina, Bulimina, Pupina. The genera of *Chilodon* are all new, although he does not so state ; but, as they are nude names, without a word of diagnosis except what may be tacitly gathered from the above arrangement, and as no species of any of them are mentioned, their bearing on nomenclature is *nil*, and none of them can be dated from 1831, or adopted at all except when defined by later authors. The group *Vortex* of Oken (1815) contained depressed Helices and Zonitids of many groups, and, as it is a composite group, and the name was not used in especial connection with *Helicodonta* until after the publications of Férussac and

Risso, it has no claim for adoption, and had better be dropped entirely.

Key to Sections of Helicodonta.

a. Spire deeply sunken, narrower than umbilicus; aperture narrow-crescentic, lip simple and retracted above, expanded and lipped outwardly and below. Nautilus-shaped, *Drepanostoma.*

aa. Spire wide, nearly level or convex.

b. Aperture triangular or square, lip teeth 2 or obsolete, periphery rounded.

c. Not ribbed; last whorl wider than preceding; spire nearly level, *Helicodonta* s. s.

cc. Small, ribbed above, last whorl narrow as preceding; spire convex, *Aspasita.*

bb. Aperture lunate or rhombic; shell much depressed.

c. Outer edge of parietal callus raised into an erect barrier, *Trissexodon.*

cc. Parietal callus thin, wholly adnate, *Caracollina.*

bbb. Aperture lunate, toothless; shell sub-globose, *Klikia.*

Species.

DREPANOSTOMA Porro. Nautiloid, biconcave, with crescentic mouth.

H. nautiliformis Porro., iii, 114. Lombardy.
drepanostoma Bk.

HELICODONTA (Fér.) Risso. Species of middle Europe.

H. angigyra Zgl. Rm., iii, 115.
stentzii Partsch
H. obvoluta Müll., iii, 115.
trigonophora Lam.
bilabiata Oliv.
holosericea Gmel.
f. dentata Held.
f. edentata West.
H. obvoluta. iii 115
f. pallida M.-T.
v. bosniaca Bttg., iii, 115.
v. blanci Poll., viii, 150.
H. holoserica Stud., iii, 116.
diodontostoma Bgt.
v. pluridentata Poll., iii, 116.
H. diodonta Mühlf., iii, 116.

Chinese species of Helicodonta.

H. subobvoluta Anc. J. B., xi, 308.
H. molina Hde.
H. biconcava Hde., iii, 117.
outangensis Crosse.
H. diplomphala Möll., iii, 124.
H. uninodata Gred., viii, 150.
H. binodata Mlldff., iii, 124.
? *bicallosula* Hde.

ASPASITA Westerlund. Transylvania, Hungaria.

H. triaria (Friv.) Rm., iii, 116.
ocskayi Stentz.
v. tatrica Haz.
H. trinodis Kim., iii, 116.
transsylvanica Haz.
H. triadis Kim., iii, 116.

TRISSEXODON Pils. Depressed, umbilicate; outer edge of parietal callus raised into a transverse lamellar barrier, constricting the mouth. Pyrennes; southern Spain.

H. constricta Boub., iii, 121.
pittorrii Dup.
H. quadrasi Hid., iii, 116.

CARACOLLINA Beck. Around the Mediterranean.

H. corcyrensis Partsch., iii, 117.
contorta, tersa Zgl.
ambliostoma Parr.
v. cephalonica Mouss., iii, 118.
f. minor.
v. octogyrata Mouss., iii, 118.
v. canalifera Ant., iii, 118.
v. girva Friv., Rm., iii, 118.
H. gyria Roth., iii, 117,
H. barbata Fér., iii, 118.
H. lusitanica Pfr., iii, 117.
H. tarnieri Morel., iii, 118.
H. walkeri Pons., Kob., viii, 149.
H. boscæ Hid., iii, 118.
H. annai Pal., viii, 148.
H. lenticularis Mor.. iii, 120.
H. columnæ Pons., Kob., viii, 148.
H. lenticula Fér., iii, 119.
H. maroccana Mor., iii, 120.
H. calpeana Mor., iii, 120.
finitima Fér., undesc.
H. vallisnieri Stef., iii, 117.
H. lens Fér., iii, 119.
barbata Desh.
v. lentiformis Zgl., iii, 119.
v. piligera Bl. & W.
abantisorum Serv.
v. callojuncta West.
v. aliostoma West., iii, 120.
v. elia Bttg.
H. lentina Mart.
H. turriplana Mor., iii, 120.
H. rangiana Fér., iii, 121.
rangii auct.
H. barbula Charp., iii, 120.
bituberculata Fér.
guerini Ant.
bidentifera Phillips.
H. barbella Serv.
H. camerani Less.
H. gougeti Serv., iii, 121.
H. tlemcenensis Bgt., iii, 120.
v. pechaudi B., Anc.
H. supracostata Kob., viii, 149.
H. buvignieri Mich., iii, 121.
asturica Pfr.

Canary Island Species.

H. lenticula v. virilis Mouss., iii, 119.
subtilis Lwe.
H. hispidula Lam., iii, 122.
v. subhispidula Mouss.
v. bertheloti Fér.

H. parryi Pons. & Sykes.
H. afficta Fér., iii, 122.
H. planaria Mouss., iii, 122.
H. discobolus Sh., iii, 123.
H. fortunata Sh., iii, 123,
H. pthonera Mab., iii, 123.
H. everia Mab., iii, 123.
H. marcida Sh., iii, 123.
H. crispolanata Woll., iii, 123.
H. beata Woll., iii, 123.
H. gomeræ Woll., 123.
H. eutropis Shutt. iv., 36.

Section *Klikia* Pilsbry, 1894.

Shell depressed-globose, narrowly umbilicated, with convex, obtuse spire and round periphery. Surface costulate-striate and minutely papillose in regular diamond pattern. Last whorl constricted behind the lip, which is well reflexed and thickened. Type *H. osculum* Thomae, pl. 71, fig. 49.

This apparently extinct type of *Helicodonta* is characteristic of middle European Miocene, where it coexisted with species of *Caracollina*, such as *phacodes* Thomae, and with species of typical *Helicodonta; H. involuta* Thomae being allied to the recent *angigyra* and *biconcava*. The strong differentiation of these sectional groups at as early a period as the lower Miocene (when they were, in fact, as strongly differentiated as in the recent fauna), argues a vastly greater antiquity for the genus as a whole. This group is named in honor of Gottlieb Klika, author of an excellent memoir upon tertiary land and fresh-water shells of Bohemia.

Subgenus Moellendorffia Ancey, 1887.

Möllendorfia Anc., Conch. Exch., May, 1887, p. 64.—Pilsbry, Man. Conch., vi, p. 10.—*Proctostoma* Mabille, Bull. Soc. Mal. de France, iv, p. 102, 103, 104, 1887 (for *H. loxotatum*).—*Polygyra* and *Cepolis* of some authors.—*Trihelix* Anc., *t. c.*, p. 64 (for *H. horrida*).

Shell depressed, with *low-convex, flat or concave spire of* 4½–5½ *whorls*, rounded or keeled periphery, and convex, *umbilicated* base. *Surface more or less granular*, tubercular or hairy, uniform brown, dull and opaque. Apical whorl rather large; *last whorl deeply deflexed in front, with deep pits or grooves behind the lip.* Aperture very oblique or subhorizontal, trigonal or squarish, the *lip expanded and reflexed, continuous across the parietal margin*, sometimes solute; *basal lip armed with a stout tooth, outer lip with one or two large entering folds.* Type *H. trisinuata* Martens (see pl. 40, figs. 16, 17, 18, *H. hensaniensis* Gredl.; pl. 56, figs. 20, 21, 22, *H. erdmanni* Schmacker & Boettger).

Anatomy unknown. Distribution, southeastern China, Tonquin and Cambodia.

Among Old World Helices this peculiar group can only be compared with the typical Helicodontas (*obvoluta, holoserica, diodonta,* etc.) of Europe and China. From these, *Möllendorffia* differs in the fewer whorls, continuous peristome, etc. Still, I find no differences of generic value in the shells; and, unless the anatomical features prove peculiar, we can hardly accord the group higher rank than subgeneric. In America, we find analogical shell structures in *Pleurodonte* (*Labyrinthus*) *leucodon* and its allies, which somewhat resemble *H. trisinuata;* and *H. horrida* may be compared with *Epiphragmophora* (*Averellia*) *macneilli* Crosse; but these are merely adventitious resemblances, due to the action of mechanical causes, which have produced tridentism in many diverse groups of Helices,

H. loxotatum Mab., vi, 13.
H. trisinuata Mart., vi, 11.
v. sculptilis Möll., vi, 12.
H. eastlakeana Möll., vi, 12.
H. hensaniensis Gredl., vi, 299.
H. erdmanii Schm. & Bttg. Proc. Mal. Soc. Lond., i, pl. 9.
H. faberiana Möll., vi, 10.
H. biscalpta Hde., vi. 9.
H. horrida Pfr., vi, 9.

Genus ALLOGNATHUS Pilsbry, 1888.

Allognathus Pils., Man. Conch. (2), iv, pp. 121, 149, type *H. grateloupi.*—Kobelt Nachrbl. D. M. Ges., 1891, p. 140.—*Cf.* Schuberth, Archiv f. Naturg., lviii, 1892, pp. 38, 61, pl. 4, f. 10, 11 (anatomy).

Shell globose, thin, smooth, imperforate, with low spire of about 4½ whorls and obtuse apex; last whorl descending in front, pale, with five spotted bands. Aperture round-lunate, oblique; lip expanded, in the middle of the base closely appressed, the columellar margin arcuate and rather wide. Type *H. graellsiana* Pfr., pl. 43, figs. 39, 40.

Jaw arcuate with a median projection, *its surface entirely smooth.*

Radula very large (length 7, breadth 4 mill.). *Teeth all of the same form, strap-shaped,* bent in a half circle, the cusp single, simple and blunt (pl. 36, fig. 2, teeth from above, fig. 3, profile of cusps). Outer teeth similar but somewhat smaller.

Genital system resembling that of *Helix* but the sacculated uterus extends far downward; the spermatheca duct is swollen

below, and bears in the middle a diverticulum 27 mill. long, not bound to the uterus. Dart-sack large (6 mill. long), containing a a four-bladed dart with expanded funnel-shaped crown ; above the sack are inserted two mucus-glands, each split into two large, club-shaped fingers. Penis 16 mill. long, cylindrical, the retractor muscle terminal; flagellum 37 mill. long (pl. 36, fig. 1, *A. graellsiana* Pfr.).

This genus is founded upon a single species inhabiting the Baleric Islands. The shell furnishes no characters of more than specific value, separating it from such species of *Otala* as *beaumieri*, etc. ; and it is by no means impossible that this and some other species, such as *H. quedenfeldti* Mts., may prove to belong to *Allognathus*. Notwithstanding this similarity of shell, we find in the anatomy profound differences from all other Pentatæniate Helices. The jaw is smooth, as in *Leucochroa;* the teeth are very aberrant in the narrow basal-plates which curve over into a blunt, strap-like cusp, entirely lacking side cusps, and they are alike over the whole radula. The genital system presents a resemblance to *Campylæa* in the two-fingered mucous glands, but is otherwise more like the Pentatæniate groups. We are disposed to consider *Allognathus* a special modification of the *Helix* stock, comparable to the *Polymita* off-shoot from *Hemitrochus*.

A. graellsiana Pfr., iv, 150.
grateloupi Graells not Pfr. *tessellata* Fér., not Mühlf.

Genus LEPTAXIS Lowe, 1852.

Leptaxis Lowe, Ann. Mag. N. H. (2), ix, p. 164, Feb., 1852; P. Z. S. 1854, p. 164, type *H. erubescens* Lwe.—*Katostoma* Lwe., P. S. S. 1854, p. 166, type *H. phlebophora* Lwe.—*Macularia* sp. Lwe., *t. c.*, p. 166.—*Cryptaxis* Lwe., *t. c*, p. 168, type *H. undata* Lwe.—*Campylæa* sp. Lowe.—*Pseudocampylæa* Pfr., Mal. Bl. 1877, p. 8; Nomencl. Hel. Viv. 1878, p. 162, types *lowei* and *portosanctana*.—*Lampadia* Alb. MSS., Lwe., P. Z. S. 1854, p. 197, type *H. webbiana* Lwe. (Not "Lampadie," Montf., French vernacular name for *Lampas* Montf.).—*Mitra* Alb., Die Hel. 1850, p. 115, type *H. webbiana;* (not *Mitra* Lamarck.)

Shell of moderate or large size, globose, globose-depressed or lens-shaped and keeled, imperforate (rarely umbilicate), the surface striate, plicate, granulated or malleated; rather thin; uniform

brown, banded or maculated. Whorls 5 to 6, the last wide, deflexed in front. Aperture transverse-oval, oblique, the outer lip simple or expanded, columella usually widened. Type *H. erubescens* Lowe. (See pl. 43, fig. 41, *L. undata;* fig. 36, *L. lowei*; fig. 45, *L. webbiana*).

Jaw (pl. 67, fig. 20 *L. undata*) well arched, strong, bearing very widely unequally *separated linear riblets, converging below, forming median triangle.*

Radula (pl. 67, fig. 19, *L. undata*) having the cusps of median teeth about as long as basal plate, side-cusps obsolete; basal plate with a backward-projecting tongue-like process. Lateral teeth with a stout ectocone. Marginals having the inner cusp shorter than usual and obtusely bifid, outer cusp simple.

Genital system (Frontispiece, figs. 8, 9, *L. undata*) having the penis continued in an epiphallus which bears the retractor and ends in a short flagellum and the vas deferens. Dart sack large, seated on atrium. Mucus glands in two clusters, one composed of 5, the other of about 10 tubes, which adhere laterally by twos or form larger palmate groups (fig. 8, d. s. turned downward and groups of mucus glands spread). *Spermatheca very large, rather boot-shaped,* with a basal cœcum embedded in uterus; duct long and without diverticulum. The penis-retractor is inserted distally on the lung floor, and the right eye-retractor passes between branches of genitalia. Dart of large size, a little curved, with a lateral expansion on each side. Spermatheca contained a rod-like chitinous spermatophore, star-like in section.

The jaw of *L. undata* is peculiar and unlike that of any allied form, resembling most the jaw of *Plectopylis.* The teeth are characterized by the strong development of ectocones on the inner laterals. The genital system is remarkable for the unusual size and shape of the spermatheca which lacks diverticulum unless it be represented by the basal sack figured. The mucus glands are in two groups, and inserted on the vagina as usual in *Helix*, but the individual tubes adhere laterally in a way I have not observed in other forms. They are not bound together like those of *Eulota*, however. The dart had unfortunately been expelled from the individuals examined, but has been described by Mörch (Journ. de Conch. 1865, p. 390).

I had expected to find in *Leptaxis* some archaic characters preserved; for its geographic position and the shell-peculiarities argue

for the group an ancient origin; but the evidence shows that however remote in the past the type was derived from the continental fauna, the main anatomical features of modern European Helices were then well established. If the genetic relationship of *Leptaxis* with Oligocene forms of middle Europe claimed by Sandberger and others be admitted (and this we have no good reason for doubting), then by implication those fossil forms were anatomically very like the modern European Helices.

It is a noteworthy fact that in no anatomical feature, whatever, does *Leptaxis* approach the West Indian groups of Helices. They have diverged from different stocks, and since Mesozoic time along widely separated paths both geographically and structurally.

Distribution, Madeira, Azores and Cape Verde groups.

(*Shell depressed, with open umbilicus and expanded peristome.* PSEUDOCAMPYLÆA. *Porto Santo.*)

L. portosanctana Sowb., iv, 199. L. lowei Fér., iv, 200.

(*Shell imperforate.* LEPTAXIS. *Madeira species*).

L. undata Lwe., iv, 189.
corrugata Sol. ms.
groviana Fér.
scabra Wood.
L. vulcanica Lwe., iv, 190.
L. leonina Lwe., iv, 190.
L. nivosa Sowb., iv, 190.
exalbida Wood.
decolorata Lwe.
v. phlebophora Lwe.
chlorata Lwe.
v. planata Lwe., iv, 191.
v. craticulata Lwe., iv, 191.
scrobiculata Lwe.
L. psammophora Lwe., iv, 191.
L. wollastoni Lwe., iv, 199.
v. forensis Woll., iv, 199.
L. chrysomela Pfr., iv, 198.
cenostoma Lwe. not Fér.
v. fluctuosa Lwe., iv, 198.
L. erubescens Lwe., iv, 191.
simia Fér.
v. portosancti Woll.
v. advenoides Lwe.
v. hyæna Lwe., iv, 192.
L. furva Lwe., iv, 192.
L. (?) exornata Dh., iv, 198.

(*Species of the Azores Is.*)

L. azorica Alb., iv, 196.
L. caldeirarum M. & D., iv, 196.
L. niphas Pfr., iv, 196.
L. terceirana Morel., iv, 197.
L. drouetiana Morel., iv, 197.
L. vetusta M. & D., iv. 198.

(*Species of the Cape Verde Is.*)

L. advena W. & B., iv, 192.
L. serta Alb., iv, 193.
L. fogoensis Dohrn, iv, 193.
L. visgeriana Dohrn, iv, 193.
L. myristica Sh., iv, 194.
L. bollei Alb., iv, 194.
L. leptostyla Dohrn, iv, 194.
milleri Dohrn.
L. primæva Morel., iv, 195.
L. atlantidea Morel., iv, 195.
L. subroseotincta Woll., iv, 195.

(*Imperforate, thin, acutely keeled, with 3 to 4 rapidly widening whorls.* LAMPADIA. *Madeira, Canaries.*)

L. webbiana Lwe., iv, 200.
Vit. bocagei Paiva.
L. membranacea Lwe., iv, 201.
L. cuticula Sh., iv, 201.

Genus FRIDOLINIA Pilsbry, 1894.

Shell large, heavy, depressed-turbinate, umbilicate when young, closed in the adult; surface obliquely coarsely malleated. Last whorl large, descending in front and strongly constricted behind the lip, swollen in the middle of the base. Aperture very oblique, toothless; peristome narrowly reflexed, its remote terminations joined by a callus, the basal and columellar margins thickened by a heavy callus within. Type *H. lucani* Tourn., pl. 71, figs. 55, 56.

This group, the type of which is a Miocene fossil of Dijon, is distinguished mainly by the tumid base, strong constriction behind the lip, and coarse sculpture. Its affinities are problematic.

Section *Pseudoleptaxis* Pilsbry, 1894.

Shell solid, imperforate, globose, sculptured with oblique wrinkles; last whorl large, rounded, constricted behind the thickened, expanded lip. Aperture lunate, oblique; columellar lip dilated. Type *H. corduensis* (Noul.) Sandb., pl. 71, figs. 57, 58.

Perhaps to the Oligocene type of this group is to be added the lower Miocene *H. ramondi* A. Braun, but that form may really belong to *Plebecula*.

Genus DENTELLOCARACOLUS Oppenheim, 1890.

Dentellocaracolus OPPENH., Denkschr. K. Akad. Wissensch. lvii, p. 117.

Shell imperforate or covered perforate, globose-conic, more or less keeled, the base rather flattened; whorls 4½ to 6½, the last

suddenly descending in front a third or more the total alt. of shell. Aperture oval or horse-shoe-shaped, horizontal; margins thickened and reflexed, joined by a callus. Type *D. damnata* A. Brong., pl. 71, figs. 53, 54.

This genus is established for certain heavy, rough sculptured Helices from the N. Italian Eocene, characterized by the extreme obliquity of the aperture, the heavy parietal callus, and the aspect of the West Indian *Pleurodonte formosa*, or the Canary Island Hemicyclas. Some *Obba* species are also similar. I am totally unable to recognize any affinity between these shells and the Antillean Helices, and regard the superficial resemblance as merely a case of convergence of shell characters, meaningless from a phylogenetic standpoint. Whether the group is to be referred to the *Epiphallogona* or the *Belogona* is doubtful, and dogmatic assertions are clearly uncalled for.

The species *damnata* Brong., *coriacea* Sandb., *amblytropis* Sdb., *hyperbolica* Sdb., *antigone* Oppenh. and *mazzinicola* Greg. belong here.

Section *Prothelidomus* Oppenheim, 1890.

Prothelidomus OPPENH., *t. c.*, p. 120.

Shell imperforate, solid, globose-depressed; whorls 4½, the last protracted and sometimes carinated toward the aperture. Aperture horizontal, oval or horse-shoe-shaped; peristome thickened, edentulous, the margins joined by a strong parietal callus. Type *P. acrochordon* Oppenh., pl. 71, figs. 51, 52.

This group is only feebly distinguished from the preceding, and as with that, I am obliged to discredit entirely the relationships implied by its name. It contains *H. acrochordon* Oppenh. (*radula* Sandb. not Pfr.), and *H. oppenheimi* de Greg. (=*H. vicentina* Oppenh. not Shaur). The sculpture of the former is like that of *Pleurodonte lima*, but the second species is smooth. This shows how much dependence is to be placed on a sculpture resemblance, a subject discussed at more length in the introduction to this volume.

H. declivis Sandb., which Oppenheim places in *Eurycratera*, may belong near or in this group or in *Dentellocaracolus*.

The peculiar minute form described by Stache as *Obbinula anthracophila* (Abh. K. K. Geol. Reichsanst. xiii, p. 119) from the *Stomatopsis* Horizon, "Cretaceo-eocene" of Carniola, may prove to

belong to the *Helicidæ*, but even this is doubtful. It occurs in company with *Stomatopsis*, a peculiar genus of *Melanopsidæ*, in beds considered to lie at the base of the Eocene. The claim of *Obbinula* to kinship with *Obba* is, there can be little doubt, an illusion.

Genus HELICIGONA Ferussac, 1819.

=*Helicigona* (Fer.) Risso,+*Chilotrema* and *Arianta* Leach, 1831,+*Chilostoma*, *Latomus* and *Isognomostoma* Fitz., 1833,+*Cingulifera*, *Corneola* and *Lenticula* Held, 1837,+*Campylæa* Beck, 1837,+*Sterna* Alb., 1850,+*Elona* Ads., 1855, etc., etc.

Shell usually depressed-globose, varying to globose-turbinate or lens-shaped, usually umbilicated, of moderate or large size; surface smooth, costulate, granulate or hairy, corneous or brown; unicolored mottled or streaked, and either with a single supra-peripheral band or with one above and one below this, or bandless. Aperture oblique, lunate or oval, the lip expanded, reflexed below and dilated at columellar insertion. Type *H. lapicida* L. (see pl. 43, figs. 19–25, 27, 28, 31–35, 42, 46).

Animal externally as in *Helix*. Jaw strong, with 2 to 16 stout convex ribs, dentating the cutting edge. Radula as in *Helix*, the ectocones sometimes developed on middle and lateral teeth, sometimes represented by lateral continuations of the mesocone.

Genitalia (pl. 62, all figs.) having the penis short, continued in an epiphallus upon which the retractor is inserted, and ending in a well developed, spirally twisted flagellum. Dart sack single, inserted rather high on vagina, containing a curved dart with round shaft and flat, 2-bladed head; the base not coronated. Mucus glands 2, long and tubular, often bifid; inserted on vagina near base of dart sack (but in *H. quimperiana* there are 3 triangular lobes on each side). Spermatheca small and globose, on a long duct; diverticulum long, larger than spermatheca-duct, connected with the uterus throughout by a broad thin membrane (shown in figs. 16, 18, removed in the other figures on pl. 62). See pl. 62, fig. 16, *H. rhætica*; fig. 17, *H. cingulata*; fig. 18, *H. planospira*; fig. 19, *H. personata*; figs. 20, 21, *H. lapicida*; figs. 22, 23, *H. arbustorum*; figs. 24, 25, 26, 27, *H. quimperiana*).

Distribution; Europe, from the Pyrenees and Greece to Sweden and England. For geological distribution see under *Chilostoma* and the extinct subgenera.

The true limits of this genus were first indicated by Schmidt, and have been confirmed by the researches of numerous later authors. The two-bladed type of dart, the broad diverticulum bound to uterus by a wide membrane traversed by blood-vessels, and the two mucus glands, which are either simple and vermiform or once split, are all characters unlike *Helix* or other genera of Belogona. The shell is never five-banded as it is in *Helix*, but has either two bands above, one below the periphery, or only the middle band is retained, or it is bandless.

The form of the dart is not alone diagnostic, for *Eremina* and some *Iberus* approach the two-bladed type. *Helicigona* is the only genus known to me in which the diverticulum is a constant generic character; and here it seems to be much more highly developed than in any other group.

The shell shows a considerable range of mutation in form and sculpture, sometimes being acutely keeled as in *H. banatica*, *canthensis* and *lapicida*, and again globose or subglobose as in *arbustorum*, *ehingensis* and the Tacheocampylæas. In some forms, such as *H. lepidotricha* and *ehingensis*, the margin of the umbilicus is obtusely angular, as in some *Chloritis;* and high authorities have indeed referred the former species to this genus. In my opinion such reference is wholly uncalled for. I would as soon consider *Lysinoe ghiesbreghti* or *Epiphragmophora rêmondi* species of *Chloritis* on account of the similar angled umbilicus and quincuncial sculpture. We must have better evidence than these unstable and frequently repeated characters, before admitting *Chloritis* to the European fauna. The claim of *Metafruticicola* (p. 276) to a place in the genus *Chloritis* is far better than that of *H. lepidotricha* and its allies. The variety of sculpture found in *Helicigona* is equally remarkable; some species being quite smooth, others, as *gobanzi* and *hemonica*, heavily ribbed; and still other forms, such as *lepidotricha*, *rahtii*, *setosa*, *benedicta* have bristles or their papillæ arranged in regular quincunx or oblique sweeps, besides a still more minute granulation of the whole surface. In some species this regular sculpture extends to the very apex, being exactly like that of *Chloritis*, *Moellendorffia* and a few other Helices of very diverse groups.

Synopsis of subgenera and sections.

RECENT GROUPS.

1. Aperture oval or lunate; lip 1-toothed or toothless.
   a. Spire convex or conoidal; mucus glands tubular.

b. Acutely keeled; lip continuous across parietal wall. HELICIGONA.

bb. Depressed, not keeled; or if keeled the lip-ends remote, *Chilostoma*, *Fruticocampylæa*.

bbb. Subglobose, with narrow or closed umbilicus.

c. Baso-columellar lip broadly reflexed, *Tacheocampylæa*.

cc. Lip narrow, dilated only at insertion, *Arianta*.

aa. Spire flat, sunken in middle; mucus glands short, triangular, ELONA.

2. Aperture ear-shaped, 3-toothed, ISOGNOMOSTOMA.

TERTIARY GROUPS.

1. Shell with pappillæ arranged in oblique series as in *H. setosa*,

a. An obtuse angle around umbilicus; periphery rounded, TROPIDOMPHALUS.

aa. Umbilicus narrow or closed; periphery acutely keeled, *Metacampylæa*.

2. Shell without regularly placed pappillæ.

a. Large, depressed, with broad peristome, MESODONTOPSIS.

aa. Subglobose, spire conoidal, peristome narrow, GALACTOCHILUS.

Section *Helicigona* (Fér.) Risso.

Helicigona FER. *l. c.* (in part).—RISSO, Hist. Nat. Eur. Mérid. iv, p. 66, first species *H. lapicida*.—*Caracolla* TURTON, Man. L. and Fr.-W. Sh. Brit. Is., 1831, p. 66, and of some other authors.—*Chilotrema* LEACH in Turton, *l. c.*, p. 66, and of Beck, *et al.*—*Latomus* FITZ., Syst. Verz., 1833, p. 97.—*Lenticula* HELD, Isis, 1837, p. 913.

Shell umbilicate, depressed, *lens-shaped and acutely keeled*; surface minutely granulous, horn-colored or dusky, obliquely streaked with brown; last whorl deeply deflexed below the keel; aperture very oblique, oval, angled at keel, the peristome reflexed below, thickened within, continuous and raised across the parietal wall, toothless. Type *H. lapicida*, pl. 43, figs. 22, 23.

Jaw with four strong ribs; radula having no side cusps on middle and lateral teeth; marginals developing an ectocone, and the large cusp become bifid. Genitalia (pl. 62, figs. 20, 21, *H. lapicida*) with penis, epiphallus and flagellum as usual. Two long mucus glands; dart-sack containing a curved dart with cylindrical shaft and short,

flat, two-edged head (fig. 21); spermatheca duct branching into a diverticulum about as long as itself.

This section contains a single species commonly distributed throughout middle and northern Europe.

H. lapicida L. iv, 117.
v. medalpedensis Cl. iv, 261.
v. andorrica Bgt.

Section *Chilostoma* Fitzinger, 1833.

Chilostoma Fitz., Syst. Verz., 1833, for *C. corneum* (=*H. cornea* Drap.), *C. zonatum* (=*foetens* Stud.) *C. pulchellum* (=*pulchella* Müll., type of the prior genus *Vallonia*).—Charp., Cat. Moll. Terr. et Fluv. Suisse, 1837, p. 8, for *cingulata, zonata, fœtens, pulchella.*—Gray, A List of the Genera of Recent Mollusca, their Synonyma and Types, P. Z. S. 1847, p. 172 (type *H. fœtens*).—Moquin-Tandon, Hist. Nat. Moll. Terr. et Fluv. France, ii, p. 131, for *fœtens* and *cornea.*—*Campylœa* Beck, Index Moll. 1837, p. 24.—Lowe, P. Z. S. 1854.—Albers, Die Hel. 1850, p. 81.—Martens, Die Hel. 1860, p. 122 (type *H. cingulata* Stud.).—*Cingulifera* Held, Isis, 1837, p. 911, for *ziegleri* Schm., *intermedia* Fér., *cingulata* Stud., *arbustorum* L., etc.—*Corneola* Held, ibid., p. 912, for *hirta, feburiana, setipila, planospira. fœtens, pulchella*, etc., etc.—*Zonites* Hartm., Gastr. Schw., p. 161, not of Montf.—*Eucampylœa* Pfr., Nomencl. Hel. Viv. 1878, p. 144.—Westerlund, Fauna, p. 103.

Shell depressed, openly umbilicated, with convex spire and rounded (rarely keeled) periphery. Surface unicolored or 1–3 banded, smooth, costulate or hirsute. Whorls about 5½, the last deflexed in front; aperture wide lunate or suboval, toothless or with a basal tooth; peristome narrowly expanded, reflexed below, dilated at columellar insertion, rarely continuous across the parietal wall. Type *H. foetens* Studer. (See pl. 43, figs. 27, 28, *H. planospira* Lam.; pl. 43, fig. 42, *H. setosa* Ziegler.)

Jaw strong, with 2 to 10 stout ribs grouped near the middle. Radula with mesocones only developed on median and lateral teeth; marginals with an inclined bifid inner and small outer cusp. Genitalia as described for the genus.

In the recent fauna this group is characteristic of the Alpine Mountain system, extending down the Italian peninsula to Sicily, and the Balkan peninsula to southern Greece. A few species occur

in south-western France. It is therefore more southern in distribution than *Arianta*, *Elona* or *Helicogona s. str.* In the lower miocene deposits of north-central Europe, a number of species typical in form occur, such as *H. inflexa* Klein, *H. exstincta* Ramb., *H. standfesti* Penecke. Specimens of *inflexa* and *standfesti* before me retain a distinct trace of the shoulder-band.

The disappearance of the name *Campylæa* from Helix nomenclature is to be regretted, and will probably fail to find many advocates for some years to come. That the course here taken is inevitable, will be obvious if the history of the name is considered. *Chilostoma* Fitz., 1833, and *Campylæa* Beck, 1837, were both proposed without diagnosis, and both contained some incongruous elements. If *undefined* names are to be rejected, then both of these must give way to *Cingulifera* Held, proposed with an excellent diagnosis in 1837. If, however, the list of species cited be accepted in lieu of a diagnosis, then *Chilostoma* must be accepted on the ground of four years' priority, as Moquin-Tandon has recognized. *In either case,* Campylæa *becomes a synonym!* Those who continue to use a generic or subgeneric name, which is so clearly inadmissable as this one, must do so in defiance of rules of nomenclature recognized as binding by zoologists generally, for *Campylæa* is neither the earliest name for the group, nor the earliest properly defined name. Neither is it the earliest properly limited group, for Beck's list contains a number of species not belonging to this genus.

H. pouzolzi Desh., iv, 87.
savignyana Ehrenb.
varronis Cantr.
brenoensis & *macarana* Mhl.
dinarica Bgt.!
? *dalmatina* Parr., *dalmatica* Dh., *gravosaensis* Muhl.
f. elevatior, depressior, bifasciata Brus.; unifasciata, unicolor Pfr., obscura Blz., kuzmici, pellanica, adriatica, tschernagorica, diocletiana, sabljari, horatii, biagioi, brenoica, daniloi, cantrainei Bgt., viii, 231.
v. montenegrina Zgl., iv, 88.
v. bosnensis Kob., iv, 88.
? *ragusana* Fér., undesc.
trizona Rve.
v. silvestris West.
H. soccaliana Let.
H. serbica Mlldff., iv, 88.
f. roschiti (Kim.) W.
f. unitæniata Bttg., iv, 88.
H. pancici Mlldff., iv, 88.
H. banatica Partch, iv, 97.
H. stenomphala Mke., iv, 88.
H. setigera Zgl., iv, 100.
f. globulosa Kucik.
H. hoffmanni, Partch, iv, 99.
monozona Z.
H. walteri Bttg., iv, 98.

H. kleciachi Parr., iv, 99.
klecaki Pfr.
H. insolita Zgl., iv, 98,
insolida auct.
subcostalis Parr.
H. prætexta Parr., iv, 99.
prætextata Kob.
H. narentina Klec., iv, 99.
v. reiseri Branc.
H. denudata Rossm., iv, 98.
H. imberbis Brus., iv, 97.
H. nicolai Klec., iv, 98.
recordera Parr.
H. trizona Zgl., iv, 108.
v. inflata Blz.
v. rumelica Z.
v. dobruschæ Cless.
v. balcanica Friv.
v. frauenfeldi Zel.
H. hæterea West.
H. cœrulens Mhl., iv, iii.
lacticini Z.
f. hyllica, depressa rugata, bukowicanica, zrmanjæ Brus.
H. cornea Drap., iv, 110.
v. castanea Rm., iv, 111.
v. squammatina Serres.
H. desmoulinsi Far. iv, 111.
moulinsii P. & M.
acrosticha Fisch.
mollerati Morel.
v. crombezi Mill.
H. pterolakæ Kob.
langi Pfr., Bttg.
H. phocæa Roth., iv, 103.
f. ornata Parr.
f. inornata Kob.
v. langi Parr., iv, 102.
H. cingulata Stud., iv, 104.
luganensis Schintz.
v. inornata Rossm.
unicolor West.
rossmässleri Cl.
v. anauniensis de Bett., iv, 105.
v. athesina Paul., iv, 105.
f. pinii Adami, iv, 106.
v. baldensis Villa, iv, 105.
v. bizona Rossm., iv, 106.
v. lucensis Paul., iv, 106.
H. carrarensis Porro., iv, 105.
v. montana Paul., iv, 107.
v. kobeltiana Paul., iv, 107.
H. planospira Lam., iv, 89.
vittata Jan.
v. etrusca Kob.
v. stabilei Paul.
f. illasyaca Adami.
v. ullepitschi West., iv, 90.
v. kobeltiana Cless., iv, 90.
v. illyrica Stab., iv, 90.
v. padana Stab., iv, 90.
f. euganea Stab., iv, 91.
v. erjaveci Cless.
v. istriana Stoss.
v. pubescens Tib., iv, 91.
v. casertana Paul., iv, 91.
v. alifaensis Paul., iv, 92.
v. calva Kob., iv, 91.
depilata Orsini.
v. setulosa Brig.
setipila Zgl.
setosa Costa.
setulosa Auct.
v. cantabrica Paul., iv, 91.
f. depressa Paul.
f. globosa Paul.
v. neapolitana Paul., iv, 91.
f. depressa Paul.
f. luteola Paul.
v. cassinensis Paul., iv, 91.

v. occultata Paul.
v. pavelii Haz.
H. tiesenhauseni Gredl., viii, 227.
H. macrostoma Mhl., iv, 92.
siculina Zgl.
pervia & didyma Mhl.
v. ereta Paul., iv, 92.
v. cryptozona Zgl.
v. confusa Ben., iv, 92.
H. benedicta Kob., iv, 92.
lefeburiana Phil.
setipila Benoit.
v. trichothroa Bgt.
v. choelotricha Bgt.
H. schlærotricha Bgt., iv, 96.
sclerotricha Auct.
H. hirta Mke., iv, 89.
deplana Zgl.
H. lefeburiana Fér., iv, 89.
feburiana Auct.
hirsuta Brumati.
H. sadleriana Zieg., iv, 89.
H. möllendorffi Kob., iv, 95.
H. hazayana Cless., iv, 89.
H. setosa Zgl., iv, 97.
f. convexior W.
f. litoralis Brus., iv, 97.
H. brusinæ Stoss., iv, 98.
v. velebitana Klec.
H. crinita Sandri, iv, 100.
H. preslii Schm., iv, 104.
cingulata Held.
v. nisoria Rm., iv, 104.
intermedia Paul.
v. nicatis Costa iv, 101.
v. affinis Paul., iv, 106.
v. appelii Kob., iv, 105.
v. anconæ Gent., iv, 106.
v. agnata Paul., iv, 107.
v. amathia Bgt.
H. colubrina Jan., iv, 105.
v. nubila Zgl., iv, 106.
v. fascelina Z., Gred.
H. gobanzi Ffld., iv, 107.
v. sigela Bgt.
v. compsopleura Bgt.
v. perfecta Bgt.
H. tigrina Ch. & Jan., iv, 107.
v. subtigrina Bgt.
H. frigida Jan., iv, 101.
f. insubrica Jan., iv, 101.
H. cingulella Zgl., iv, 104.
zinguletta H. & A. Ad.
f. gyrata West.
f. scutellata West.
H. pyrenaica Dr., iv, 94.
v. complanata Bgt., iv, 95.
xanthelœa (B.) Fag.
v. semiclathrata West.
H. faustina Zgl., iv, 95.
v. sativa Z.
v. associata Z.
favirensis Parr.
v. citrinula Z.
v. charpentieri Schol.
v. fortunata Parr.
v. subflava Kim.
H. rossmässleri Pfr., iv, 96.
advena Rm., preoc.
v. bridayi Branc.
H. phalerata Zgl., iv, 100.
v. chamæleon Parr., iv, 101.
H. glacialis Thom., iv, 109.
v. vesulana Less.
v. chiophila Bgt.
H. alpina F.-B., iv, 100.
v. alpicola West.
v. fontenilli Mich., iv, 100.
tigrina v. michaudiana Rm.
H. schmidti Zgl., iv, 103.

H. hessei Kim., iv, 103.
H. hermesiana Pini, iv, 100.
v. frigidescens DelPrete, iv, 105
v. apuana Iss., iv, 105.
v. ligurica Kob., iv, 101.
v. frigidissima Adami.
H. nicolisiana Ad., viii, 227.
H. intermedia Fér., iv, 109.
catenulata Muhl.
cornea Brum.
H. ziegleri Schm., iv, 109.
H. æmula Rossm., iv, 109.
ambrosia Strobel.
martinatiana de Betta.
H. ichthyomma Held, iv, 93.
v. achates Z., iv, 93.
cingulina Dh.
achatina P. & M.
foetens C. Pfr., iv. 93.
H. zonata Stud., iv, 92.
v. flavovirens D. & M.
v. monozonata Poll.
v. modesta Moq., iv, 92.
H. foetens Stud.
v. millieri Bgt., viii, 228.
H. strobeli Less.
H. cisalpina Stab., iv. 94.
gallica Bgt.
sebinensis Kob.
adelozona Parr.
v. debettai Ad. iv, 94.
v. adamii Kob., iv, 94.
v. rhætica Mouss., iv, 94.
H. argentellei Kob., iv, 94.
H. peritricha Bttg., viii, 230.
v. erymanthia Kob.
H. kollari Zel., iv, 94.
H. hemonica Thiesse.
H. pindica Bttg., iv, 96.
H. choristochila Bttg., iv, 102.
H. gasparinæ Charp., iv, 102.
v. subdeflexa Bttg., iv, 102.
H. olympica Roth, iv, 101.
thessalonica Mouss.
v. ossica Bttg., iv, 102.
v. magnesiæ Bttg., iv, 102.
v. sciara West.
H. broemmei Kob., viii, 229.
H. conemenosi Bttg., viii, 229.
v. acarnanica Kob., viii, 220.
H. oetæa Mart.
H. subzonata Mouss., iv, 93.
v. distans Bl. & W., iv, 93.
v. depressa Bttg., viii, 228.
H. brenskei Bttg., iv, 113.
H. comephora Bgt., iv, 96.
comythophora Bttg.
f. krüperi Bttg.
H. eliaca Kob.
H. cyclolabris Desh., iv, 114.
v. euboea Parr.
v. arcadica Parr.
v. hymetti Mouss.
v. sphæriostoma Bgt.
lysistoma Shutt.
v. heldreichi Shutt.
v. amorgia West.
v. grelloisi Bgt., iv, 114.
v. bacchica Mart.

Section *Fruticocampylæa* Kobelt, 1871.

Fruticocampylæa KOBELT, Catal. Eur. Binnenconch., p. 13.

Shell with moderate or small umbilicus, rather depressed, the surface granulated or spirally striated, generally with a peripheral

white band bordered above and below by dark bands; aperture oval, basal lip expanded. Type *H. ravergiensis* Fér. (pl. 43, figs. 24, 25; *H. narzanensis* Kryn.).

Anatomy unknown. This group of Campylæa-like shells is confined to the Caucasus region and adjacent lands to the south. It may prove to belong to the *Hygromia* series, but is better left here until examined anatomically. The distribution of *Fruticocampylæa* is not continuous with that of other Helicigonas.

H. appeliana Mouss., iv, 85.
appelinsi Auct.
v. mediata West.
H. narzanensis Kryn., iv, 84.
hortensis Ménétr.
ossetinensis Bayer.
f. bicingulata Bttg.
f. castanea Bttg.
f. subunicolor Bttg.
f. perlineata Mouss.
v. suanetica Bttg.
v. macromphala Bttg.
v. cyclothyra Bttg.
v. olivacea Bttg.
v. kobensis Bttg.
v. depressa Bttg.
H. pratensis Pfr., iv, 85.
bayerii Parr.
f. unicolor Bttg.
f. alutacea West.
v. perforata West.
v. depressa Kob.
v. solidior Kob.
H. joannis Mort., iv, 86.
dumonti Mort.
H. dichrozona Mart.
H. delabris Mouss., iv, 86.
f. alia West.
H. pontica Bttg., iv, 86.
H. nymphæa Dub.
H. ravergiensis Fér., iv, 85.
ravergii Kryn.
ravergieri Bttg.
limbata Kryn.
caucasica Pfr.
v. persica Bttg., iv, 85.
H. transcaucasica Bay., iv, 85.
f. pygmæa Bttg.
H. phæolema Bttg., iv. 87.
H. eichwaldi Pfr., iv, 86.
v. daghestana Parr., iv, 86.
H. armeniaca Pfr. iv, 86.
airumia Siem.
? *nivalis* Ménétr.
? *menetriesii* Kalen.

Section *Tacheocampylæa* Pfeiffer, 1877.

Tacheocampylæa Pfr., Malak. Bl., xxiv, 1877, p. 8, type *H. raspaili* Payr. See for anatomy, Moq.-Tand., pl. 12, f. 11–14.

Shell depressed with low spire, the body whorl not keeled; imperforate or partly covered umbilicate; smoothish, sometimes hairy; brownish, yellowish or olive, with two bands above, one below the periphery. Aperture truncate-oblong, very oblique; outer lip

reflexed, baso-columellar lip straightened or arcuate, its edge broadly dilated and reflexed. Type *H. raspailii*, pl. 43, figs. 33, 34, 35.

Jaw (of *H. raspaili*) arched, with three separated ribs. Epiphragm flat, thin and membranous, with some calcareous particles. Genital system furnished with a curved dart (pl. 63, fig. 7 *H. raspailii*) 10–12 mill. long, swollen and channelled at base, then constricted, widening again in the middle, four bladed (?). Mucus glands four-fingered.

This group has the characteristic shell of *Campylæa*, but the four-fingered mucus glands and the apparently quadrangular dart are characters like *Tachea* and *Otala*. It may prove to be a transition group. A further investigation is needed to demonstrate its affinities, and especially should the dart and the diverticulum of the spermatheca duct be examined, as these structures afford the only criterion for the separation of the true Helices from the *Campylæa* or *Helicigona* group. The species are all from Sardinia and Corsica.

H. raspailii Payr., iv, 112.
  v. acropachia Mab.
  v. lenelaia Mab.
  v. pilosa Kob., iv, 112.
  v. garciai Hagenm.
H. insularis Cr. & Deb., iv, 112.
H. brocardiana Dut., iv, 112.
  v. omphalophora Dut.
  v. sciaphila Hagenm.
  v. donata Hagenm.
H. cyrniaca Dut., iv, 112.
  revelierii Deb., iv, 112.
  planospira Payr.
  tachigyra West.
  v. montigena Hagen.
  v. faucicola Hagen.
H. gennarii Paul., iv, 113.
H. carotii Paul., iv, 112.
  f. major, unifasciata, viperina, lamarmoræ, spectrum, Malzan, iv, 113.
H. melonii Malz., iv, 113.

Unfigured forms: *H. vittalacciana* Mab., *romagnolii* Dut., *melliniana* with var. *deschampsiana*, and *arusalensis* Hagenmüller.

Section *Arianta* Leach, 1831.

Arianta Leach in Turton's L. and Fw. Shells Brit. Is., p. 35 (for *H. arbustorum*).—Beck, Index, p. 41 (in part).—Hartmann, Gast. Schw., p. 55.—*Arionta* v. Martens, Die Hel., 1860, p. 127, (exclusive of all but type, *H. arbustorum*). Not *Arionta* of American authors!

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Shell globose or globose-depressed, with convex or conoidal spire, and narrow or closed umbilicus; surface shining, spirally striated, usually with a supraperipheral band, and mottled or dark coloring. Aperture round-lunate, oblique, toothless; lip expanded and white-lipped, reflexed at columellar insertion. Type *H. arbustorum* L., pl. 43, fig. 46.

Jaw with 6–10 strong ribs. Radula having outer side cusps developed on middle and lateral teeth. Marginals with bifid inner and simple outer cusps. Genital system (pl. 62, figs. 22, 23, *H. arbustorum*) showing the features usual in *Helicigona* throughout. The two simple mucus glands are very long; dart sack containing a curved dart (fig. 22) like that of *H. lapicida*. Diverticulum bound to uterus by a wide membrane traversed by blood vessels.

Distribution, middle and north Europe, upper Pliocene and Loess deposits. In the modern fauna this species or group of species, is distributed from the northern boundary of the Olive zone (Pyrenees and Alps) to Sweden, enjoying a far greater range than any other member of the genus *Helicigona*, especially in its ability to withstand the cold. The number of local races is remarkable, and their study is much complicated by the fact that forms with a similar aspect occur in widely separated localities, probably due to parallel development. Typically many of these varieties are very different, but intermediate forms seem to abolish most boundary lines; so that Kobelt, in his latest contribution on the subject, is not willing to endorse even the main forms as species (Iconogr. n. F., vi, p. 60).

The spelling of this name given above is that of Leach, Beck and other early authors. Von Martens has changed the name to "Arionta" on etymological grounds. The single well defined species *H. arbustorum*, is a typical Helicigona in anatomy, having the diverticulum bound to the uterus by a broad membrane, the two long, cylindrical mucus glands inserted on vagina, and other features diagnostic of that genus. The American species referred to *Arionta* by authors present nothing of the sort; the diverticulum has no membrane; the mucus glands are bulbiferous and inserted on dart sack, etc., etc.

H. arbustorum L., iv, 117.
v. conoidea West., iv, 118.
v. calcarea Högb., iv, 118.
v. picea Zgl., iv, 117.
wittmanni Zow.
v. jetschini Ulic., iv, 117.

H. arbustorum Linné.
v. canigonensis Boub.
canigonica Fag.
v. fagoti Bgt.
v. xatarti Far., iv, 118.
v. repellini Charp., iv, 118.
v. alpicola Fér.
alpestris Z., iv, 118.
subalpina Scholtz.
f. costulata Kob.
v. doriæ Paul., iv, 117.
v. rudis Mühlf., iv, 118.
v. corneoliformis Less.
v. styriaca Ffld., iv, 119.
H. æthiops Blz., iv, 118.
H. camprodunica Kob., iv, 118.

Other named forms of *H. arbustorum*, some of which have doubtless good claims to racial distinction. are: Var. thamnivaga, hypnicola, themita Mabille; var. dravica, vibraiana, musdorfensis, illusana Servain; var. sendtneri, excelsa, septentrionalis Clessin; var. albulana, feroeli, knitteli, nazarina, trachia (Bgt.) Serv.; var. creticola Mörch.; var. trochoidalis Roffiæn; var. depressa Held.; var. baylei (Lecoq) Moq.; var. gotlandica; oelandica West. Also *forma* flavescens, albina, rufescens, draparnaudia, poiretia, boissieria, thomasia Moquin-Tandon; *f.* efasciata Westerlund; *f.* lutescens, luteofasciata, fuscesens D. & M. (=marmorata Taylor); *f.* morbosoalbina Rossm.; *f.* nigrescens Locard, *f.* fusca Fér.; *f.* cincta (=pallida Tayl.), sinistrorsum Taylor; *f.* minima and major Pfr.

Subgenus Elona H. & A. Adams, 1855.

Elona H. & A. Ad., Gen. Rec. Moll. ii, p. 211, type *H. quimperiana* (June, 1855). Not *Elona* Moq.-Tand., 1855.—*Sterna* Albers, Die Hel., p. 93, 1850, same type (preoccupied).—See Hesse, Jahrb. D. M. Ges., xii, 1885, p. 45, pl. 3, f. 1 (anatomy).

Shell umbilicate, *planorboid, the spire slightly concave*, periphery broadly rounded; corneous with a few varicoid white stripes; aperture lunar, slightly oblique; lip white, expanded above, reflexed below, the ends distant. Type *H. quimperiana* Fér., pl. 43, figs. 19, 20, 21.

Jaw with 11–16 narrow ribs. Genitalia (pl. 62, figs. 24, 25, 26, 27, *H. quimperiana*) differing from the typical Helicigonas in having the *mucus glands shortened into triangular sacks* (fig. 26) and the dart sack is inserted in a sort of calyx at base (fig. 27). Dart curved at the end, with lens-like section (fig. 24).

This group contains a single French species remarkable for its *Chloritis*-like shell and the peculiar mucus glands. The latter con-

sist of short lobes, somewhat as in *Eulota*; but unlike that genus, they are *inserted on vagina well above the dart sack*, so there can be no doubt that they are merely a shortened form of the finger-like glands characteristic of Belogona Siphonadenia.

H. quimperiana Fér., iv, 116. Brittany; Spain.
kermorvani Coll.
corisopitensis Dh.

Subgenus Isognomostoma Fitzinger, 1833.

Isognomostoma Fitz., Syst. Verzeichniss der in Erzherzogthume Oesterreich vorkommenden Weichthiere, p. 97, sole species, *I. personatum* Eitz., =*H. personata* Drap.—*Isognomonostoma* Tryon—*Triodopsis* of modern European authors, not of Rafinesque!—*Plicostoma* Schluter, Syst. Verz., 4, 1838. See for anatomy Schuberth, Archiv f. Naturg., 1892, p. 11, pl. 1, f. 15–18 (Good!)

Shell depressed-globose, with low convex spire, narrow or closed umbilicus and rounded or faintly angular periphery; surface smooth, hirsute in quincuncial pattern. Aperture oblique, ear-shaped; *peristome flatly reflexed*, thickened within, *toothed on outer and basal margins; terminations connected by a raised, tongue-like parietal process.* Type *H. personata*, pl. 43, figs. 31, 32.

Jaw with about 5 strong ribs, dentating the cutting margin; radula with large triangular mesocones on middle and inner lateral teeth; marginals with a bifid inner and simple outer cusp. Genital system (pl. 62, fig. 19, *H. personata*) with penis as usual in the genus; 2 long mucus glands; an elongated dart sack containing a dart of typical Helicigone form, base dilated, shaft slender and round, spreading into a two-bladed, laurel-leaf shaped head. Diverticulum bound to uterus by a broad membrane, as usual in *Helicigona*.

Distribution, middle Europe and Siberia.

The anatomy of this group is typical of *Helicigona* (*Campylæa*), having the diverticulum membrane found in *that genus only*, (removed in the figure), as well as the characteristic form of mucus glands and dart. These features of the genital system, as well as the strongly ribbed jaw, show that the association of *H. personata* with "Gonostoma" is entirely illusory. In fact Schuberth, in his anatomical characterization of "Anchistoma" ("Gonostoma"+ "Triodopsis") was obliged to make an exception of *H. personata*,

and to compare it with *Campylæa;* but strangely enough he does not alter the current classification of the species. The resemblance of *H. personata* to the American Triodopsis is merely a case of incomplete parallelism. The two groups are readily separated by observing the form of the parietal barrier. Dr. H. von Ihering has ably discussed the relationships of *H. personata,* ranking it, of course, in *Campylæa.*

H. personata Drap., iii, 147. H. subpersonata Midd., iii, 147.
isognomostomos Gm. pt.
v. debilis West.

Subgenus TROPIDOMPHALUS Pilsbry, 1894.

Shell with the general characters of *Chilostoma,* but subangular around the umbilicus, and quincuncially punctate or papillate (as in some members of the *H. planospira* group). Type *H. lepidotricha* A. Braun, pl. 71, figs. 59, 60.

The lower Miocene forms for which this section is proposed have the verge of the umbilicus subangular as in most (but not all) *Chloritis* (*conf.* p. 118) and many species of *Eulota;* and in fact the group may belong to *Eulota* rather than to *Helicigona.* At all events, the closest resemblance is traceable between *H. lepidotricha* and certain southeast Asian *Eulotas.* On theoretical grounds, however, I am disposed to believe that *Eulota* has no extensive past history in Europe, being a recent straggler from East Asia; and this is supported in the main by palæontological evidence.

A thorough study of the Miocene Helices is necesssary to determine whether the peculiar sculpture which occurs in so many forms, is a character assumed simultaneously by many subgenera and genera, or an indication of actual genetic relationship. Not much evidence can be adduced in favor of the latter view from the recent fauna, for species of widely different genera exhibit the hairs or papillæ arranged in obliquely decussating series: In HYGROMIA, *H. consona, lanuginosa,* etc.; in HELICIGONA, hairy members of the *planospira* group; in THYSANOPHORA, *T. stigmatica* and its allies; in EULOTA, numerous oriental species. The list could be indefinitely increased. It will be perceived from this that those authors who insist upon the presence of *Chloritis* in the European Miocene fauna, stand upon narrow and insecure footing.

H. robusta and *trichophora* Reuss., from the lower Miocene of Tuchoric, evidently belong to this group.

Section *Metacampylæa* Pilsbry, 1894.

Shell solid, sublenticular, acutely keeled, the spire obtuse-conic. Aperture oblique, subrhombic; outer and basal lips reflexed, thickened within, the columellar insertion dilated, partly or wholly closing the narrow umbilicus. Surface minutely granulate, and with larger papillæ disposed in quincuncial order. Type *H. rahtii* A. Braun, pl. 71, figs. 45, 46.

In its acute carination, the lower Miocene *H. rahtii* is comparable to *H. lapicida* or *banatica* of the recent fauna, but its sculpture is that of *H. setosa* Zgl. The lip differs somewhat from that of any living "Campylæa," but not more than various species of that group differs from one another. *Metacampylæa* probably stands in much the same relation to *Tropidomphalus* as *Helicigona* (lapicida) does to *Chilostoma* (planospira, etc.).

H. papillifera Klika and possibly *H. obtusecarinata* Sandb., are to be referred here, but the latter may belong to the ancestral *Tachea* stock.

Subgenus Galactochilus Sandberger.

Galactochilus Sandb., Land und Süsswasser Conchyl. der Vorwelt, p. 387 (for H. pomiformis, mattiaca, ehingensis and cornumilitare).

Shell subglobose, with low, conoid spire of about 4½ whorls, the last large with rounded periphery, subangular around the narrow, partly or nearly closed umbilicus, slowly descending in front. Aperture truncate-oblong, oblique; lip obtuse, expanded on outer and basal margins, dilated at columellar insertion, partly closing the umbilicus. Surface smooth except for growth-striæ. Type *H. ehingensis* Klein, pl. 71, figs. 47, 48.

This group contains several species from the lower Miocene, *H. pomiformis* A. Braun, *Ehingensis* Kl., *mattiaca* Stein. I am disposed to believe it an off-shoot from the "Campylæa" phylum. Some specimens of H. *arbustorum* exhibit much the same subangulation around the umbilical region.

Subgenus Mesodontopsis Pilsbry, 1894.

Shell large, depressed, with convex and very obtuse spire and covered umbilicus. Whorls 5, convex, the last ornamented with two

broad bands above and one below the periphery, deflexed in front. Aperture half round, oblique; lip broadly reflexed throughout, dilated and adherent at the columellar insertion. Surface smoothish. Type *H. chaixii* Mich., pl. 71, figs. 61, 62.

This group differs from the pentatæniate Helices in having the lip more reflexed, and not forming a columellar plate. I think it allied more to the "Campylæas," with which it agrees in the color pattern (distinctly visible in specimens before me) and the general features of the aperture. I consider *Tacheocampylæa* the most nearly allied group of the recent fauna (conf. pl. 43, figs. 33–35). The resemblance to *Mesodon* is merely superficial. It is likely that *H. brocchii* Mayer from the upper Pliocene belongs here rather than to *Galactochilus*. It is umbilicate and one-banded above; but I have not seen that species, nor *H. ludovici* Noul. and *ornezanensis* Noul. from the Miocene freshwater chalk of southwestern France, which may also find a place in this group. The type, *H. chaixii*, is from the middle Pliocene of Hauterive.

Genus (?) CYRTOCHILUS Sandberger.

Cyrtochilus Sandb., Land u. Süsswasser Conchyl. der Vorwelt, p. 386 (for *H. expansilabris* Sandb.). Not *Cyrtochilus* Jak., 1875, or Meek, 1876, nor *Cyrtochila* Feld, 1874.

Shell globose-conoid, with 5 convex whorls separated by linear sutures, the last whorl large, ventricose, broadly constricted behind the lip; surface of all but first whorl obliquely costulate and decorated with minute papillæ arranged in quincuncial order. Aperture oblique; outer and basal lips expanded, columella narrow, vertical, closing the umbilicus. Type *H. expansilabris* Sandb., pl. 71, fig. 50.

The shell has the figure of *H. platychela* of Sicily, but it is sculptured like a hairy *Chilostoma*. The single species is from the lower Miocene of Hochheim.

Genus HELIX Linné, 1758.

Helix Linne (in part), Syst. Nat., x, p. 768.—Lam., Syst. Anim. s. Vert., 1801, p. 94, *H. pomatia* only.+*Pomatia, Tachea, Otala, Macularia, Iberus, Eremina, Euparypha, Hemicycla*, etc., etc.

See for anatomy A. Schmidt, Der Geschlechtsapparat der Stylommatophoren in taxonomischer Hinsicht, in Abhandl. naturwis-

senschaftl. Vereins für Sachsen u. Thüringen in Halle, i, pp. 1–52, pl. 1–5, 1856, and Zeitschr. f. Malak., 1850, vii, p. 1–13, pl. 1 (darts); Ibid, 1849, p. 49.—C. Brancsik, Sexualapparate einiger Moll. des Trencsiner Comitates in Jahresheft des naturw. Vereins der Trenc. Com., Trencsin, 1890, p. 19–22, pl. 1–3.—R. Lehmann, Die lebenden Schn. u. Musch. der Umgebung Stettins u. in Pommern,1873.—Moq.-Tand., Hist. Nat. Moll. Terr. et Fluv. Fr., 1855. —O. Schuberth. Beitr. zur Vergleich. Anat. des Genitalapparates von Helix, in Arch. f. Naturg. lviii, i, 1892, p. 1–65, pl. 1–6.—Pollonera, Bull. della Soc. Mal. Ital. xii, 1885, p. 111 (best figs. of dentition).—Erdl, in Moritz Wagner's Reisen in der Regentschaft Algier, 1836.—Paasch, Archiv f. Naturg., 1843 and 1845.—F, Wiegmann, Jahrb. d. m. Ges. iv, 1877, p. 195, pl. 6–8.—Baudelot. Ann. Sc. Nat. (4), Zool. xix, 1863.—Ashford, Journ of Conch., Leeds, Vol. iv, 1883–'85.—v. Ihering, Morph. u. Syst. des Genitalapparates von Helix, Zeitschr. f. Wissenschaftl. Zool. liv, 1892, p. 386–520.—C. F. Jickeli, Fauna der Land u. Süsswasser Moll. Nord-Ost-Afrika's, in Nova Acta Acad. Cæs. Leop.-Carol. Germ. Nat. Cur. xxxvii, 1875, *et al.* See for palæontology of *Helix:* Sandberger, Land- u. Süsswasser-Conchyl. der Vorwelt, with the authorities cited therein; Klika, Tert. Land- und Süsswasser-Conch. N. W. Böhmen, (*cf.* Bttg., Verh. K.-K. Geol. Reichsanst., 1891, p. 228); Penecke, Zeitschr. D. geol. Ges. xliii, p. 346; Oppenheim, Denkschr. k. Akad. Wissensch. lvii, p. 113 (*cf.* Tausch, Verh. K.-K. Geol- Reichsanst., 1891, p. 198, and de Gregorio, Ann. de Geol. et de Paléont. 10e Livr., 1892), etc., etc.

Shell varying from globular to depressed and from rounded to acutely keeled, imperforate or narrowly umbilicated, rather solid, with about 5 whorls; surface striate, ribbed, malleated or granulose. Five-banded, or having fewer or no bands by the absence or coalesence of some or all; rarely having more bands by splitting of bands or interpolation of lines. Lip either expanded, reflexed or thickened within. Type *H. pomatia*, frontispiece, fig. 7, (See pl. 44).

Animal with a tough, granulose or reticulate integument, marked by two or few grooves along back, the tail depressed, with a slight median line or none; *facial grooves well developed on both sides.* Labial processes large; sole undivided. Mantle with a small right body lappet, and a long left one, usually interrupted across the

back. Right eye retractor passing between primary branches of genitalia. (Frontispiece, fig. 7).

Jaw well arched, stout, with 3–9 strong ribs denticulating both margins (pl. 67, figs. 1, 4, 7, 8, 9). Radula normal, having the cusps of median and lateral teeth about as long as the squarish basal plates, side cusps small or wanting. Marginals with a long, oblique bifid inner cusp and a small simple or bifid ectocone (pl. 67, figs. 2, 3, 5, 6, 11).

Genital system characterized by *a short penis passing into the epiphallus, which bears the retractor* (distally inserted on lung floor) and branches into vas deferens and a flagellum, the latter rarely wanting. *One dart sack present* and well developed, containing a *four-bladed dart*, with short neck and crenulated base. *Mucus glands two, varying from simple to multifid, but always composed of smooth, tubular cœca; inserted on each side of vagina immediately above entrance of dart sack; both the dart sack and mucus glands lying free* in cavity, *not* bound together by a stout membrane. Spermatheca globose, on a long duct, which usually bears a diverticulum. Ovotestis compact, imbedded in the side of the liver (frontispiece figs. 5, 6, *H. pomatia*).

Distribution, Europe, North Africa, Asia Minor.

Helix is distinguished from *Helicigona* mainly by the form of the dart and the *free* diverticulum; this being invariably bound to oviduct by a wide membrane in *Helicigona*.

The genus *Helix* contains the most highly organized and complex snails of the family *Helicidæ*. Like the European type of *Homo*, but unlike most highly specialized forms, their specialization has evidently fitted them for meeting widely diverse conditions of existence. Their powers of reproduction as well as the ease with which they adapt themselves to circumstances of climate and environment new to them, are remarkable. They love the light, and for the most part are not exterminated by the destruction of their native forests, but accepting kindly the new conditions, live and multiply in vineyards, gardens and around tilled fields. As colonists they rank with man, the dog and the horse. Various species live and thrive in the United States, Mexico, Cuba, Argentina, S. Africa, New Caledonia, Australia, etc., etc. None, even of the most widely distributed Helicoids of other genera such as *Eulota similaris*, have so wide a range of climate; and the species of *Helix* which

have founded colonies in climates foreign to them, outnumber the colonized members of all other Helicoid genera together.

The causes of this adaptability are obscure. Perhaps the rather unusual toughness of the external integument and the unrivalled complication of the genitalia are factors of importance, the first allowing them a wider range of station with greater variety and opportunity of feeding, the second producing more perfect eggs. It is noteworthy that the dentition is of a very generalized type, showing no tendency toward the specialization seen in the radulæ of *Polymita, Oxychona, Papuina*, or the entire series of genera grouping around *Acavus, Helicophanta* and *Panda*. Such high modification of dentition as these genera show, must restrict them to the special conditions and food which produced it, and would constitute a bar to their wide dispersal, which is not present in the genus *Helix*. The jaw is of high type, but the same efficient odontognathous form has been developed in many genera.

With the exception of *Euparypha* and *Eremina*, no divisions of *Helix* can be based upon anatomical characters, for the features intergrade throughout, offering merely specific differences. The various "sections" of the genus rest wholly upon conchological characters, which though quite appreciable to the eye, are often extremely difficult to define in words so that they may be distinguished.

The genus *Helix* is abundantly represented in the Tertiary deposits of middle Europe, by species belonging without doubt to the modern groups, although in many cases they are practically intermediate between some of the latter. The HELICOGENA or *Pomatia* group is not known with certainty below Pleistocene deposits, although it is barely possible that the Oligocene *H. globosa* Sowb. belongs here. I do not think this likely; and the evidence at hand indicates that the group arose upon non-European soil, and spread northward or northwest in a few specific forms which have split in comparatively recent times into numerous species. TACHEA, however, has an extensive range in time, a considerable number of forms appearing in lower Miocene deposits, some showing certain features of *Iberus*, others with more conoidal spire than usual in normal recent Tacheas, but still having the characteristic columella and band pattern. *H. bohemica, H. moguntina* and *H. hortulana* are examples, being the "Coryda" of some European authors, so-called on account of the trifling incident of a raised spire. Such forms as *H. crepidostoma* Sandb., with keeled earlier whorls, are also to be regarded as

a manifestation of this group. In the upper Miocene, *H. sylvana*, *sylvestrina*, etc., represent this group. In late Pliocene and Post-Pliocene times, Tachea was represented by numerous forms, such as *sepulta* Mich., *tonnensis* Sandb., and those described by Nevill from Mentone. The section OTALA (*Macularia* Auct.) has a similar history, appearing at about the same time, in moderately characteristic forms, many with the malleation of the recent species, as seen in *H. nayliesi*, etc. HEMICYCLA, now confined to the Canary Islands, seems to have had a wide range in the Miocene, some species, such as *asperula* Dh. being excessively similar to recent forms. The isolation of the Canaries has evidently preserved there this ancient race. There are a number of Tertiary forms of Europe known to me by figures or poorly preserved specimens only, which will eventually no doubt form new groups.

H. doderleiniana All. of the Sicilian Pliocene seems to represent a section distinct from *Otala*, although allied to that group, which may be called *Allolœmus*. It is distinguished by the extraordinary expansion of the last whorl toward the aperture, after a wide shallow constriction, causing the throat to be quite narrow, although the mouth is expanded and the outer lip flaring. General form globose-depressed. The specimen before me is from Palermo, collected by Benoit.

It has not been considered necessary to give varietal names to the band variations of these five-banded Helices. They may better be expressed by the well known formula originated by Martens père (Ueber die Ordnung der Bänder an den Schalen mehrerer Landschnecken, 1832), and explained in the Introduction to this volume.

Synopsis of sections and subgenera.

I. Penis provided with a flagellum.

a. Baso-columellar lip straightened and widened by a callous plate within.

b. Imperforate, globose-conic, periphery round, smoothish; usually yellow or white, banded *Tachea*.

bb. Imperforate, globose-depressed, periphery round, smooth or malleated, solid; uniform, or speckled and banded *Otala*.

bbb. Globose-depressed, malleated, ribbed or granulate, dark, usually banded *Hemicycla*.

bbbb. Globose or depressed, smooth or striate, with spotted bands *Iberus* (in part).

aa. Baso-columellar lip concave, not wide or flat.

b. Large, globular; lip simple or expanded *Helicogena.*

bb. Depressed, often keeled, ribbed or striate, 0–4 banded *Iberus* (part); *Levantina.*

II. Penis without flagellum; shell chalky.

a. Globose-depressed, heavy, the lip expanded or thickened; bands few or none *Eremina.*

aa. Globose or depressed, decussated above, the outer lip not in the least expanded, thickened within; bands many, rarely none *Euparypha.*

Section *Helicogena* Férussac, 1819.

Helicogena (part) Ferussac, Tab. Syst. Fam. Limaçons, p. 27.—Risso, Hist. Nat. Eur. Mérid., p. 60, first species *H. pomatia.*—Charpentier, Cat. Moll. Suisse, 1837, p. 5, for *H. pomatia* only.—Hartmann, Gastr. Schw., p. 98 (for *H. pomatia*).—Moq.-Tand., Hist. Nat. Moll. Fr. ii, p. 179.—*Pomatia* Leach, in Turton's Manual of the Land and Freshwater Shells of the Brit. Is., 1831, p. 45.—Beck, Index Moll., p. 43, and of authors generally.—*? Lucena,* Hartmann in Syst. Erd- u. Süsswasser Gastr. Eur., p. 40, 1821.—*Pomacea* Perry, Conchology, pl. 38, 1811 (in part; but diagnosis agrees better with *Ampullaria* species also included).

Cantareus Risso, Hist. Nat. Eur. Mérid., p. 64, (*Helix naticoides* sole species).—Moq.-Tand., *l. c.*, p. 186.—*Canthareus* Agassiz, Nomencl. Zool., 1847.—*Tapada* Gray, in Turton's Manual L. and Frw. Sh. Brit. Is. edit. 1840, p. 127, *H. aperta* sole species.

Cryptomphalus Agassiz in Charpentier, Catal. Moll. Terrest. et Fluv. de la Suisse, in Neue Denkschriften der allg. Schweizerischen Gesellsch. für die gesammten Naturwissensch. (=Nouveaux Mémoires de la Société Helvétique des Sci. Nat.) i, 1837, p. 5, for *arbustorum, aspersa, sylvatica, nemoralis.*—Moq.-Tand., *l. c.* p. 174, restricted to *H. aspersa.*—*Cœnatoria* Held, Isis, 1837, p. 910, for *aspersa, lucana, lutescens, pomatia,* etc.—*Erctella* Monts., Naturalista Siciliano xiii, No. 9, June, 1894, for *H. mazzullii.*

Shell *globose* or globose-conoid, *capacious,* with about 4½ rapidly widening whorls; umbilicus narrow or closed; aperture large, not

very oblique, lunate; outer lip simple or expanded, columella long, concave, not thickened within, its edge reflexed. Type *H. pomatia* L., Frontispiece, fig. 7; (see also pl. 44, figs. 6, 7, *H. asemnis var. vetusta*).

Animal large with wide fleshy foot, the sole undivided; above coarsely granose-reticulate; right and left facial grooves strongly marked; labial tentacles well developed; mantle edge bearing a bluntly rounded right body lappet and a similar left one, the latter either continuous or interrupted over the back, but reappearing in a broad rounded lobe on the left side. Top of tail rounded, with a subobsolete median line or none; back from mantle to head with a pair of longitudinal grooves. (Frontispiece, fig. 7, *H. pomatia*). *H. aperta*, *H. aspersa* and other species examined show the same external characters.

Jaw strong, arcuate, with several stout ribs denticulating both margins. Radula (pl. 67, fig. 11, *H. pomatia*) with well developed ectocones on central and lateral teeth; marginals with bifid inner and small simple outer cusps.

Genitalia: Penis short, passing into a short epiphallus upon which the retractor is inserted, the epiphallus ending in a long flagellum and vas deferens. Dart sack unusually large, containing a four-bladed dart, the blades long, separated from the coronated base by a neck or constriction (pl. 61, fig. 11, *aspersa;* fig. 15, *pomatia*). Mucus glands usually divided into several branches subdividing into very numerous fingers, but sometimes (*H. aperta*, *asemnis*) the number is as low as four or five. Seminal receptacle globular, on a long, nearly straight duct, which usually bears a diverticulum. Hermaphrodite duct much knotted; hermaphrodite gland compact. (Frontispiece, figs. 5, 6, *H. pomatia*, Oberau, Bavarian Tyrol. Pl. 61, figs. 12, 15, *H. pomatia*. Pl. 61, fig. 9, *H. asemnis*. Pl. 61, figs. 13, 14, 11, *H. aspersa*).

The typical Helicogenas agree with the types of *Otala* and with *Tachea vindobonensis* in having the mucus glands divided and subdivided into many "fingers"; but as in *Otala* and *Tachea*, this is an inconstant feature, the number being 4 or 5 in some species. The main character of the group is its globose shell, and this offers a perfectly tangible sectional feature. The dart sack is larger than in the related sections except *Tachea*. There is usually a diverticulum developed on spermatheca duct, but in *H. pomatia* and some other species it is generally absent.

It has been considered best to revert to Férussac's name *Helicogena* for this group, as the well known name *Pomatia* must in any case be abandoned in favor of *Cantareus*, properly proposed five years earlier. *Pomatia*, moreover, is etymologically identical with *Pomatias*, the name referring to the calcareous epiphragm, and not of latin derivation as some have supposed. Strictly speaking, no sectional name is required for this section, as it is the typical group of *Helix*.

The species are European in distribution, but the greater number occur in Southern Europe, Northern Africa and Asia Minor. *H. aspersa* is the most widely dispersed, and has become colonized in many localities in both North and South America, as well as in Australia, etc. Most species of this group are edible and used for food in the latin countries as well as in Turkey, Greece and the Orient.

(I. *Imperforate, solid, malleated, lip expanded throughout; epiphragm membranous,* CRYPTOMPHALUS).

H. aspersa Müll., iv, 235.
grisea Gmel.
variegata Gmel.
H. aspersa.
secunda Da C.
fluminensis Lang.

Thin, plicate or striate, lip hardly expanded, *Erctella.*

H. mazzullii Jan., iv, 235.
crispata Costa not Fér.
retirugis Mke. (undescr.).
rugosa Mühlf.
costæ Ben.
f. zonata Bgt.
v. quincayensis (Maud.) Bgt.
quincianensis Mauduyt.
H. vermiculosa Morel. iv, 149.
f. cretacea Westerl.
H. subaperta Ancey.
mazzulopsis Anc., viii, 238.
H. subplicata Sowb., iv, 236.
H. tristis Pfr., iv, 254.
cerasina Sh.
H. aggerivaga Mab., iv, 255.

II. *Imperforate or umbilicated, the lip hardly expanded; epiphragm rigid, calcareous,* HELICOGENA.

Thin, globular, imperforate and unicolored, with large aperture and dark coloration, *Cantareus.*

H aperta Born, iv, 254.
terrestris Forsk.
neritoides Ch.
naticoides Drap.
Southern France to Greece, N. Africa.
v. korægælia Bgt., Loc.
v. kalaritana Prunn., Villa.

Shell strong, often umbilicate, usually banded. *Helicogena.*

H. pomatia L., iv, 236.
antiquorum Lch.
pomaria & scalaris Müll.
v. gesneri Hartm., iv, 237.
pyrgia Bgt.
v. rustica Hartm., iv, 237.
radiata Ulic., iv, 238.
v. pulskyana Haz., iv, 237.
v. sabulosa Haz., iv, 237.
v. hajnaldiana Haz., iv, 237.
v. compacta Haz., iv, 237.
v. solitaria Haz., iv, 237.
ensarcosoma Serv.
v. piceata Gredl., iv, 237.
brunnea Porro.
v. lednicensis Branc., iv, 238.
v. thessalica Bttg., iv, 238.
v. lagarinæ Adami, iv, 238.
v. pyrgia Bgt.
v. segalaunica Sayn.
v. promæca (Bgt.) Loc.
v. gratiosa Gredl.
H. buchii Dub., iv, 238.
abichiana Bayer.
H. leucorum L., iv, 239.
mutata Lam.
v. yleobia Bgt.
v. virago Bgt.
depressa Bgt.
v. ryparia Bgt.
v. nigrozonata Bgt.
v. atrocincta Bgt.
v. anaphora West.
v. castanea Oliv., iv, 239.
mahometana Bgt.
v. euphratica v. Mts., iv, 240.
v. rumelica Mouss., iv, 240.
v. onixiomicra Bgt., iv, 240.
v. elongata Bgt., iv, 240.
v. straminea Brig., iv, 240.
f. straminiformis Bgt.
v. taurica Kryn., iv, 241.
H. radiosa Ziegl.. iv, 241.
H. schlæflii Mouss., iv, 241.
v. præstans Bl. & W.
H. secernenda Rm., iv, 242.
v. insignis Branc.
H. valentini Kob., viii, 239.
H. ligata Müll., iv, 242.
? annularis Perry.
decussata Parr.
melissophaga Costa.
varians Ziegl.
f. pomatella Tib., iv, 243.
f. prætutia Tib., iv, 243.
f. campana Tib., iv, 243.
f. delpretiana Paul., iv, 243.
f. truentina Masc., iv, 243.
f. pseudopomatia Bl., iv, 244.
f. rupicola (Bl.) West.
v. albescens Jan., iv, 244.
v. interamnensis Bgt.
v. dichromolena Bgt.
v. gussoneana Sh., iv. 243.
H. ambigua (Parr) Mss. iv, 244.
cyrtolena Bgt.
f. clathrata West.
v. aetolica Kob., viii, 239.
acarnanica Kob.
v. thiesseana Kob., iv, 244.
H. anctostoma Mts., iv, 244.
beilanica West.
H. cincta Müll., iv, 245.
lemniscata Brum.
dalmatica Mühlf.
v. pollinii DaC., iv, 245.

v. calabrica Kob., iv, 243.
albescens Adami.
v. trojana Kob.
v. anatolica Kob.
v. cypria Kob.
H. asemnis Bgt., iv, 245.
solida Ziegl.
v. homerica Mart., viii, 239.
v. venusta Mart., pl. 44, f. 6, 7.
H. moabitica Goldfuss.
H. melanostoma Drap. iv, 246.
f. pachypleura Bgt.
f. vittata Rm., iv, 245.
pronuba West.
f. candida Rm., iv, 247.
rugosa Ant.
f. nupta West.
v. nucula Parr., iv, 247.
v. cathara West.
v. giuliæ Bgt.
v. uticensis (Bgt.) Péch.
v. melanonixia Bgt.
H. figulina Parr., iv, 247.
v. pomacella Parr., iv, 247.
H. pachya Bgt., iv, 248.
v. texta Mouss., iv, 248.
v. dehiscens Westerl.
pachya Kob., Icon., f. 1031, not Bgt.
H. pathetica Parr., iv, 248.
H. socia Rm., iv, 248.
H. philibinesis Friv. Rm., iv, 249
philibensis Pfr.
H. nilotica Bgt., iv, 249.
H. vulgaris Parr., iv, 249.
obtusata Ziegl., preoc.
obtusalis Mouss.
f. vallionis Ret.
v. bicincta Dub., iv, 250.
H. lutescens Ziegl., iv, 250.
cinerascens Andr.
H. nordmanni Parr., iv, 257.
H. raddei Bttg., iv, 251.
H. christophi Bttg., iv, 251.
H. prasinata Roth, iv, 252.
H. cavata Mouss., iv, 252.
H. engaddensis Bgt., iv, 253.
H. pycnia Bgt., iv, 253.
H. godetiana Kob., iv, 253.
latecava Mouss.
H. malzani Kob., iv, 254.

H. equitum, luynesiana, jauberti, edroea, schahbulakensis Bgt., (iv, p. 256) are unfigured and insufficiently known forms.

Section *Tachea* Leach, 1831.

Tachea Leach, TURTON, Manual of the Land and Freshwater Shells of the British Is., 1831, p. 33 (*nemoralis* and *hortensis*).—HARTMANN, Erd- u. Süsswasser-Gasterop. Schweiz, pp. 24, 189, 212, 1840.—*Helicogena* (part) FERUSSAC, BECK, etc.—*Cepœa* HELD., Isis, 1837, p. 910.—*Archelix* (second section) ALB., Die Hel., 1850, p. 98.

Shell imperforate, globose or subdepressed, with low-conoid spire and rounded periphery; bright colored, usually yellow, with five dark bands, any or all of which may be absent. Whorls 5, the last

deflexed in front, tumid. Aperture wide-lunar, oblique; lip expanded and thickened within, the baso-columellar margin straight, widened by a blade-like callus within, flattened and adnate. Surface smoothish. Type *H. nemoralis* L., pl. 44, figs. 4, 5.

Animal showing a pair of longitudinal grooves on back and indistinct right and left facial grooves, elsewhere coarsely granular; sole very indistinctly tripartite; mantle-edge with small right and minute left body-process on each side of breathing pore.

Jaw (pl. 67, fig. 1, *H. nemoralis*, Würzburg) solid, arcuate, with 4–6 strong ribs grouped in the median part and denticulating either margin. Radula having the middle cusps only developed on central and lateral teeth, the side-cusps represented by a slight lateral wave, but in some forms they are present and minute. Marginal teeth having the inner cusp long, oblique and bifid, outer cusp small, simple (pl. 67, figs. 2, 3, *H. nemoralis*).

Genitalia: penis long, bearing a long flagellum; duct of spermatheca very long and usually with a diverticulum. Dart sack muscular, containing a four-bladed dart, with conspicuously coronated base and long head, the blades split in some species. Mucus glands two, inserted on opposite sides of vagina immediately above *d. s.*, each subdivided into several long, slender cylindrical finger-like cæca (pl. 63, fig. 12, *H. nemoralis*).

Distribution, entire Europe.

Tachea is one of the most conspicuous and characteristic forms of European snail life. They live on bushes and walls, in gardens, vineyards, etc., and, while avoiding the direct rays of the sun, are light-loving creatures. They colonize freely, *H. nemoralis* increases rapidly where introduced in America. *H. hortensis* inhabits many of the islands off the New England coast, and being found in pre-Columbian kitchen-midding deposits, cannot be regarded as a recent immigrant. Possibly it may be the sole survivor of that Viking incursion in the eleventh century.

The variations of the Tacheas are mostly in coloring, and it has not been considered worth while to give below the multitude of names founded on band-variations, etc. There is considerable variation in the size of dart sack, and in the darts of various species, as well as in the number of fingers of the mucous glands, which are generally quite long (15–16 mill. in *nemoralis, splendida, coquandi*, 29 in *vindobonensis*), and vary from four in each group in *nemoralis* to from 16 to 30 in *vindobonensis*.

H. atrolabiata Kr., iv, 124.
calligera Dub.
v. stauropolitana Schmidt.
v. leucoranea Mousson.
v. pallasii Dubois.
v. decussata Boettger.
v. intercedens Retowski.
v. nemoraloides Martens.
H. vindobonensis Fér., iv, 124.
austriaca Mühl.
mutabilis Hartm.
arvensis Kryn.
H. subaustriaca Bgt.
H. nemoralis Müll., iv, 122.
f. pura West., Verh. k. k. z.-b. Ges., '92.
v. erjaveci Kobelt.
v. lucifuga Hartm.
appenina Stabile.
genuensis Porro.
H. hortensis Müll., iv, 123.
subglobosa Binn.
H. sylvatica Dr., iv, 125.
v. montana Stud.
v. rhenana Kob.
? v. litturata Pfr., iv, 126.
"*litturea*," iv, 126 (err.).
H. coquandi Mor., iv, 125.
f. nemoraloides Kob.
f. nahoni Kob.
f. ellioti Kob.
f. depressa Kob.
H. splendida Drap., iv, 147.
f. roseolabiata Rm.
v. cossoni Let., iv, 148.
v. calæca Fag.
H. aimophila Bgt., iv, 126.
v. tchihatcheffi Kob., iv, 126.
v. aimophilopsis Villes, iv, 126.
H. vicaria West., Nachr., 1894, 168

(*Quaternary fossil species from Mentone.*)

H. paretiana Issel, iv, 130.
monaecensis Ramb.
H. œdesima Nev.
v. colorata Nev.
v. crassior Nev.
H. mentonica Nevill.
H. bennetiana Nev.
H. williamsiana Nev.
v. subnemoralis Nev.
v. spanias Nev.

Two species described by Deshayes are referred to this group by Pfeiffer. H. gibbosula Desh., iv, 126, and H. filosa Desh., iv, 126. Their localities are unknown, and subsequent authors have not identified them.

Section *Otala* Schumacher, 1817.

Archelix Alb., Die Hel., 1850, p. 14, 21, 98 (exclusive of section *b*).—*Macularia* Martens Die Hel., 1860, p. 132, and of authors generally, not *Macularia* Albers, 1850.—*Helicogena* in part of Férussac, Risso, Beck, et al.—*Otala* Schum., Essai d'un nouv. Syst., p. 191 (for *hæmastoma, atomaria* = *lactea, sulcata* = *Plicadomus*).—Moq.-Tand. (in part), Hist. Nat. Moll. Fr., ii, p. 142.—Not *Otala* Beck, 1837, Index, p. 35.

Shell depressed-globose, imperforate, solid, somewhat cretaceous; white, unicolored or banded, a five-banded pattern usually traceable. Surface usually finely malleated. Last whorl rounded at periphery, deeply deflexed in front. Aperture very oblique, truncate-oval, the outer lip expanded and thickened within, basocolumellar lip straightened, reflexed and adnate, widened by an internal callus. Type *H. lactea* Müll., pl. 44, fig. 11 (see also pl. 44, figs. 9, 10, *H. vermiculata*).

Animal externally like *Tachea.*

Jaw arcuate with blunt ends and 4 to 7 strong, convex ribs dentating both margins (pl. 67, fig. 4, *H. vermiculata*). Radula similar to that of *Tachea*, side cusps being developed in some species, absent in others (pl. 67, fig. 5, *H. vermiculata*).

Genitalia (pl. 63, fig. 8, *H. vermiculata*) similar to *Tachea*, but in the typical species the mucus glands are split into a great number of cæca, as in *Pomatia.* Dart coronated at base, with four blades, which may be either simple (*H. alonensis*, pl. 63, fig. 13) or divided (*H. vermiculata*, pl. 63, fig. 5). In the group of *H. alonensis, balearica, minoricensis*, etc., the mucus glands have few fingers, as in *H.* (*Tachea*) *nemoralis.*

Distribution, southern Europe, Northern Africa, Canary Islands.

This section differs from *Tachea* in the more compact, solid shell with generally a more deflexed last whorl and irregular color-pattern. It presents no constant anatomical difference from *Tachea*, but in most species the fingers of the mucus glands are more numerous.

The name *Otala* was proposed for three species, placed in two sections. Section *a* contained *hæmastoma* (which, being the type of a prior genus, must be eliminated, see *ant.* p. 153), and *atomaria*, a new name for *lactea* Müll. Section *b* contained the *Helix sulcata* of Müller, a form which Swainson, in 1840, made the type of his group *Plicadomus.* These eliminations leave *H. lactea* the valid nucleus of Schumacher's group, and this name should have been adopted by Albers in 1850; but, instead, he coined a new one—*Archelix.* This name was dropped in Marten's edition of Die Heliceen, 1860, and the species placed in *Macularia*, a group originally proposed by Albers for the spotted and unkeeled *Iberus*, and which did not originally contain the species *vermiculata*, which Martens names as its type! As the the type of Macularia had been expressly said to

be *niciensis* by Lowe in 1854, Martens action clearly cannot be sustained; and, unless we use the name *Otala* for this group, it must be called *Archelix*. Beck's use of *Otala* has no bearing upon the case, as he included none of Schumacher's species in his group.

H. vermiculata Müll., iv, 128.
muraloides Chier.
v. thalassina Porro.
v. grimaldiensis Nev.
v. uticensis Kob.
v. gaidurina Bl. & W.
v. saharica Kob., iv, 128.
v. linusina Ben.
linusæ Calc.
v. subangulata Iss., iv, 129.
v. pelogosana (Stoss.) West.
H. punica Morel., iv, 129.
H. constantinæ Fbs., iv, 129.
cirtæ Terv.
v. fleurati Bgt., iv, 129.
H. bogharіensis Deb., iv, 129.
H. lactea Müll., iv, 130.
irrorata Say.
atomaria Schm.
f. bertheri Bgt. (albino).
v. ezquerriana Bgt.
v. turturina (Guirao) Rm.
v. maura (Guirao) Rm.
simocheila (Bgt.) Serv.
v. sevillensis Serv.
v. sevilliana (Grat.) Mss.
v. murcica Rm.
v. axia Bgt.
v. malacensis Anc.
v. bleicheri Palad. iv, 132.
stomatodœa Bgt.
v. ibrahimi Bgt.
v. sphæromorpha Bgt.
v. plesiasteia Bgt.
v. bathylæma Bgt., iv, 130.
v. alybensis Kob., iv, 130.
v. tagina Serv., iv, 130.
H. gibbosobasalis Woll., iv, 131.
H. atavorum Mab., iv, 131.
H. ahmarina (B.) Mab., iv, 131.
H. punctata Müll., iv, 131.
myristiqmœa (Bgt.) Péch.
f. galena (Bgt.) Péch.
v. punctatissima Jen.
v. bredeana Deb.
v. apalolena Bgt., iv, 132.
H. tingitana Pal., iv, 132.
H. lucasi Dh., iv, 132.
H. ghazouana Deb., iv, 133.
H. hieroglyphicula Mich., iv, 133.
oranica Bgt.
f. integrivittis Anc.
H. alabastrites Mich., iv, 134.
soluta Mich.
v. pycnochilia Bgt.
H. atlasica Mouss., iv. 134.
H. alcyone Kob., iv, 134.
H. juilleti Terv., iv, 134.
chottica Anc.
saidana Deb.
v. marguerittei (B.) Pch.
v. heliophila (B.) Pch.
H. bailioni Deb., iv, 135.
H. denansi Kob., iv, 135.
H. beguirensis Deb., iv, 135.
beguirana Auct.
H. wagneri Rossm., iv, 136.
H. charieia Pech., iv, 136.
H. jourdaniana Bgt., iv, 136.
H. arichensis Deb., iv, 137.
v. crassidens Deb., iv, 137.
v. catodonta (B.) Pech.

v. lobethana Deb., iv, 137.
H. zaffarina Terv., iv, 137.
v. zelleri Kob., iv, 138.
f. doubletti Bgt.
H. anoterodon Péch., iv, 138.
H. dupotetiana Terv., iv, 138.
H. brevieri Péch., iv, 139.
dupot. v. aspera Gass.
v. rugosa Kob.
euglyptolena Bgt.
v. subbrevieri Bgt.
H. xanthodon Ant., iv, 139.
v. ema Bgt.
v. pseudoembia Bgt., iv, 141.
H. arabica Terv., iv, 139
v. abrolena Bgt.
H. odopachya Bgt., iv, 140.
H. bonduelliana Bgt., iv, 140.
v. asteia Bgt.
H. leucochilops Pils., iv, 240.
leucocheila W., not Cox.
H. senilis Morel., iv, 140.
H. subsenilis Cr.
H. embia Bgt., iv, 140.
H. burini Bgt., iv, 141.
H. tigri Gerv.. iv, 141.
tigriana Bgt.
maresi Cr.
v. stereodonta Bgt.
v. dicallistodon Bgt.
H. surrodonta Bgt., iv, 142.
H. dastugui Bgt., iv, 142.
H. subjobæana Kob., iv, 142.
H. jobaeana Cr., iv, 142.
H. beaumieri Mouss., iv, 149.
H. raymondi Moq., iv, 149.
desfontanea Morel.
H. efferata Mousss., iv, 145.
H. moussoniana Woll., iv, 145.
adonis Mouss., not Ang.
H. alonensis Fér., iv, 146.
f. lorcana Rossm.
v. carthageniensis Rossm.
v. campesina Ezq.
v. bajoi (Bgt.) Serv.
v. loxana Rossm.
H. alcarazana Guir., iv, 147.
H. guiraoana Rossm., iv, 147.
v. augustata Rossm., iv, 147.
H. ebusitana Hid.
H. marmorata Fér., iv, 147.
exornata Parr.
v. menobana (Bgt.) Péch.
v. violacea Rossm.
pulchella Rm.
partschii Bgt.
H. balearica Ziegl., iv, 148.
hispanica Partsch.
speciosa Ziegl.
f. valdemusana Bgt.
f. eustrapa Bgt.
v. companyonii Aler. iv, 148.
companyoi West.
pyrenaica Rossm.
v. palmana (Berth.) Bgt.
H. minoricensis Mitt., iv, 148.
minorica (Berth.) B.
f. sampoli (Bgt.) Péch.
H. massylæa Morel., iv, 144.
v. zenatia Kob., iv, 144.
H. prædisposita Mss., iv, 145.
H. rereyana Mss., iv, 145.
H. codringtoni Gray, iv, 143.
ferussaci C. & J.
eucincta Bgt.
euchromia Bgt.
eupœcilia Bgt.
v. pseudoparnassia Mss.
v. lycica Mart.
v. callirhoë Rolle.

subsp. parnassia Roth., iv, 143.
subsp. oetæ Kob., iv, 143.
f. alba Kob.
v. ætolica Bttg., iv, 143.
subsp. crassa Pfr. iv, 144.
blanci Bgt., mss.
v. pantocratis Broem.
v. coracis Kob.
subsp. intusplicata Pfr. viii,
v. subangulata Kob. [240.

Unfigured and imperfectly known species or forms of Otala.

H. miloni, parisotiana, hermieri, chydopsis, of (Bgt.) Péchaud. H. ramisi, catharolena, toukriana, galiffetiana, eugastoria, bandotiana, agenna. lucentumensis, acanonica, nitefacta, sticta, azorella, lamprimathia, takredica, romalea, brocha, seignetti, Bgt. H. cantæ chorista, tiranoi (Bgt.) Serv. H. æcouria, mattarica Let & Bgt. H. seguyana, acatergastra, speiratopa, bouthyana, alabastra Péchaud. H. duriezi Deb. H. flattersiana Anc.

Section *Hemicycla* Swainson, 1840.

Hemicycla Swainson, Malacology, p. 331, type *H. plicaria* Lam. —*Mycena* Alb., Die Hel., 1850, p. 123.—*Cochlea* (part) Adanson *et al.*

Shell imperforate or umbilicate, globose-depressed, solid and opaque; 5-banded, but the number frequently reduced by the absence of band v or the coalesence of bands ii and iii, sometimes all bands obsolete. Surface strongly striate, decussated or *malleated*. Whorls 4½ to 6, the last deflexed in front. Aperture very oblique; lip reflected throughout, thickened within, the baso-columeller margin wider, usually flattened and appressed, often obliquely toothed. Young shells angular or keeled. Type *H plicaria* Lam., pl. 43, fig. 43 (see also pl. 43, fig. 44, *H. saulcyi* Orb.). Anatomy unknown.

Distribution, Canary Islands. Although the anatomy of this group is still unknown, the close correspondence of its shell to *Otala* renders its systematic position moderately certain. The soft parts will probably prove the same as in other pentatæniate snails, unless an earlier stage of development be retained in fewer-branched mucus glands. The Canary Island fauna is much less individualized than that of the Madeira, Azores and Cape Verde groups, and in its Helices it seems much more nearly allied to that of the Mediterranean tract. The number of species will probably be somewhat reduced by more critical study of their variations.

H. plicaria Lam., iv, 151.
plicatula Lam.
orbiculata Wood.
planorbula Gray.
H. chersa Mab., iv, 153.
H. benthencourtiana Sh., iv, 151.
H. sarcostoma W. & B., iv, 152.
v. thaumalea Mab., iv, 152.
H. paeteliana Sh., iv, 152.
H. bathycoma Mab., iv, 153.
H. eucalypta Mab., iv, 154.
H. sabiniana Mab.. iv, 154.
H. zelota Mab., iv, 154.
H. ephedrophila Mab., iv, 155.
H. themera Mab., iv, 155.
H. riprochi Mab., iv, 155.
H. janthina Mab., iv, 156.
H. gravida Mouss., iv, 156.
H. bathycampa Mab., iv, 157.
H. subgravida Mab., iv, 157.
H. barckeriana Mab., iv, 157.
H. cacopista Mab., iv, 158.
H. cateucta Mab., iv, 158.
H. justini Mab., iv, 159.
H. helygaia Mab., iv, 159.
H. cacoplasta Mab., iv, 159.
H. callipona Mab., iv, 160.
H. perrieri Mab., iv, 160.
H. verneaui Mab., iv, 161.
H. idryta Mab., iv, 161.
H. hedonica Mab., iv, 161.
H. galdarica Mab., iv, 162.
H. ledrui Mab., iv, 162.
H. ethelema Mab., iv, 163.
H. agaetana Mab., iv, 163.
H. saulcyi Orb., iv, 164.
v. temperata Mss., iv, 164.
H. baia Mab., iv, 164.
H. embritha Mab., iv, 165.
H. crypsidoma Mab., iv, 165.
H. stulta Mab., iv, 165.
H. carta Mab., iv, 166.
H. retrodens Mouss., iv, 166.
H. pouchet Fér., iv, 167.
adansoni W. & B.
H. desculpta Mouss., iv, 167.
H. modesta Fér., iv, 167.
paivana Lwe.
H. idiotrypa Mab., iv, 168.
H. malleata Fér., iv, 168.
bidentalis Lam.
v. nivariæ Woll., iv, 169.
H. glasiana Sh., iv, 169.
pellislacerti Rv.
H. glyceia Mab., iv, 170.
H. empeda Mab., iv, 170.
H. fritschi Mouss., iv, 170.
H. consobrina Fér., iv, 171.
v. vetusta Mouss.
H. evergasta Mab., iv, 171.
H. cacopera Mab., iv, 172.
H. bathyclera Mab., iv, 172.
H. thanasima Mab., iv, 173.
H. ephora Mab., iv, 173.
H. cardiobola Mab., iv, 173.
H. guamartemes Grass.. iv, 174.
manriquiana Lwe.
guartemes Martens.
H. invernicata Mouss., iv, 174.
H. maugeana Sh., iv, 175.
gaudryi Rv.
H. distensa Mouss., iv, 175.
H. hedybia Mab., iv, 176.
H. perraudierei Grass., iv, 176.
H. hierroensis Grass., iv, 176.
valverdensis Lwe.
H. indifferens Mouss., iv, 177.
H. gaudryi Orb., iv, 177.
v. evergeta Mab.
v. gaudryopsis Mab.

H. granomalleata Woll., iv, 178.
H. vermiplicata Woll., iv, 178.
H. amblasmodon Mab., iv, 179.
H. zorgia Mab., iv, 179.
H. planorbella Lam., iv, 180.
villiersii Orb.
v. incisogranulata Woll.
H. inutilis Mouss., iv, 181
H. plutonia Lwe., iv, 181.
H. semitecta Mouss., iv, 181.
H. paivanopsis Mab., iv, 182.
paivana Morel., not Lwe.
H. quadricincta Morel., iv, 182.
H. berkeleii Lwe., iv, 186.
H. saponacea Lwe.. iv, 183.
H. psathyra Lwe., iv, 183.
H. thespesia Mab., iv, 183.
H. bituminosa Mab., iv, 184
H. merita Mouss., iv, 185.
H. harmonica Mouss., iv, 185.
H. gomerensis Morel., iv, 185.
H. thoryna Mab., iv., 185.
H. hedeia Mab., iv, 186.
H. digna Mouss., iv. 186.

Section *Iberus* Montfort, 1810.

Iberus Montf., Conch. Syst. ii, p. 146, type *I. gualterianus*.—*Euiberus* Westerl. Fauna Paläaract. Binnenconch., Helix, p. 367, 1889, same type.—*Macularia* Albers, Die Hel. 1850, p. 80.—Lowe, P. Z. S. 1854, p. 166, type *H. niciensis* Fér.—H. & A. Ad., Gen. Rec. Moll. ii, p. 210. Not *Macularia* of v. Martens and subsequent authors.—*Murella* Pfr., Mal. Bl. xxiv, p. 8, proposed for *H. serpentina, surrentina, theresæ, strigata, carseolana, melitensis, provincialis, muralis*.—Monts., Moll. Terrest. della Isole adiacenti alle Sicilia, p. 32, 33, restricted to group of *H. serpentina*.—*Transiberus* Monts., Moll. Terrestri, etc., (in Atti della R. Accad. di Scienze, Lettere e Belle Arti (3) ii), p. 33, 1892; proposed for Sicilian *Iberus*.

Shell rather cretaceons, imperforate or partly covered perforate, varying from depressed or lens-shaped to globular; solid, smooth or wrinkled, with 0 to 5 spiral bands. Last whorl rounded or keeled, deflexed in front. Aperture very oblique, subovate. Lip expanded on outer and basal margins and thickened within; columellar lip reflexed, dilated toward insertion. Type *H. gualtierana* L., pl. 44, fig. 8. See also pl. 44, fig. 15, *H. scabriuscula;* figs. 16, 17, *H. muralis;* fig. 18 *H. sicana.*

Jaw (pl. 67, fig. 7 *H. serpentina*) with 3–6 ribs, denticulating the margins. Sometimes the ribs are almost obsolete. Radula characterized by the lack of side cusps on central and lateral teeth, the middle cusps being about as long as the basal plates. Marginals with a long bifid inner cusp and small simple or bifid ectocone (pl.

67, fig. 6 *H. serpentina*). Genital system (pl. 61, fig. 8 *H. gualtieriana;* pl. 61, figs. 6, 7, *H. muralis;* pl. 63, fig. 1, 2, 3, *H. serpentina*). Penis rather short, the retractor and epiphallus inserted at its apex, epiphallus ending in a moderately long flagellum. Spermatheca globular, on a long duct which bears a diverticulum. Dart sack as in *Otala.* Mucus glands two, simple, or each dividing into two or three branches. Dart four-bladed, with expanded, feebly crenulated base (pl. 63, figs. 1, 2, *H. serpentina*).

The anatomy of *Iberus* is like that of *Otala* except in the fewer fingers of the mucus glands. In this respect, both *Tachea, Helicogena* and *Otala* exhibit great variation; and the same is true of *Iberus.* It is perfectly clear that no characters whatever, for the separation of these groups, can be obtained from the soft anatomy. They rest wholly upon conchological characters. The dart is not of the typically four-bladed type in some species, although it is in *H. gualtierana.* In *serpentina* it seems more like a modified two-bladed form.

The group *Iberus* was originallyp roposed for *H. gualtierana* only, so that Westerlund's name *Euiberus* seems to me wholly superfluous. The next published name for the group was *Macularia* of Albers, proposed for the species with rounded periphery and spotted bands. Albers selected no *type* from his list, but in 1854 Lowe named *H. niciensis* as the type. The name *Macularia* was used for the species of Albers original list by Mörch (Catal. Yoldi, 1852), by H. & A. Adams (Gen. Rec. Moll. 1855) and others, so that both by the formal selection of a type from the original list of species, and by usage in well-known publications, the name became fixed. It was, therefore, directly contrary to the fundamental principles of nomenclature for Albers-Martens in the second edition of Die Heliceen (1860) to shift the name to the group of *H. vermiculata;* and although this unlawful usage has been followed by all later authors to this day, it is too obviously unjustified to stand longer uncorrected. As to the synonymy of the other sectional names, it would seem that in the absence of characters their discussion is not worth the ink it would cost.

Bourguignat believes that the north African group of globose Iberus, such as *H. sicanoides,* is a modification of the *H. raymondi* stock (Bull. Soc. Mal. Fr. i, p. 7).

I. *Iberus* s. str. Keeled and depressed, coarsely latticed. Mucous glands several-branched.

H. gualtierana L., iv, 202.
obversa Born.
v. laurentii Bgt. *Spain.*

II. *Murella* Pfr. Mucus glands simple.
Keeled species: Group of H. sultana; Algeria, Tripoli, Morocco.

H. sultana Morel., iv, 202.
subscabriuscula Bgt.
H. culminicola Pons., viii, 234.
H. viola (Pons.) Kob., viii, 234.
H. leachii Fér., iv, 203.
tripolitana Wood.
H. quedenfeldti Mart., viii, 235.

Keeled species: Group of H. scabriuscula; Sicily, Sardinia.

H. scabriuscula Db., iv, 203.
erycina Jan.
v. verrucosa Monts., viii, 233.
v. selinuntina Ph., iv, 203.
v. segestana Ph., iv, 203.
v. explanata Ben., iv, 204.
v. demissa Ben., iv, 204.
v. drepanensis Huet., iv, 204.
scalariformis Ben.
H. nadorrica West., viii, 233.
tumidosa Monts.
H. paciniana Ph., iv, 204.
vieta Rm.
f. eulasia Westerl.
H. grohmanni Phil., iv, 205.
H. sardonia v. Mts., viii, 236.
v. dorgaliensis Mts., viii, pl. [26, f. 38.
H. buelowi Malz., viii, 236.

Globose species: Group of H. sicanoides; Morocco, Algeria.

H. weberi Kob., viii, 236.
platycheloides Kob., iv, 211.
H. boettgeri Kob., iv, 211.
H. gyrostoma Fér., iv, 212.
H. tetuanensis Kob., iv, 213.
H. sicanoides Kob., iv, 213.
H. sollieri Bgt.

Globose or globose-depresssed: Group of H. muralis. Sicily, etc.

H. sicana Fér., iv, 213.
soluta Zgl.
H. platychela Mke., iv, 209.
prætexta Jan.
v. rosaliæ Ben., iv, 209.
v. iparia Ben., iv, 209.
v. connexa West. *Rm.* f. 593.
H. ascheræ Kob., iv, 210.
H. ragusæ Kob., iv, 208.
H. provincialis Ben., iv, 208.
H. melitensis Fér., iv, 207.
f. caruanæ Pils., iv, 208.
H. ridens v. Mts., viii, 236.
f. splendens Malz., iv, 211.
f. minor Malz., iv, 211.
H. globularis Ziegl., iv, 206.
frivaldskyi Calc.
f. conspicua Ben., iv, 207.
f. cossurensis Ben., iv, 207.
f. undulata Kob., iv, 207.

f. achatina Ben., 207.
f. saracena Ben.
v. tarentina Kob., iv, 207.
v. latilabris Westerl.
H. rollei Malz., viii, 236.
H. arista Westerl.
H. caltabellotensis Kob., viii, 232.
H. talamonica Kob., viii, 231.
H. tiberiana Ben., iv, 206.
H. muralis Müll., iv, 205.
abromia Bgt.
v. rugosa Ziegl., iv, 205.
v. costulata Ben., iv, 205.
v. crispata Ben., iv, 206.
v. alutacea Paul., iv, 206.
v. insularis Ben., iv, 206.
v. undulata Mich., iv, 206.
communis Ben.
orgonensis Philb.
v. abræa (Bgt.) Mab.
v. ciofaloi Cafic.
v. messanensis Suliotti.
v. substrigata (Bgt.) Mab.
H. eugenia Pfr., iv, 221.
vigenia Parr.
calypso Ben.
v. huetiana Ben., iv, 221.
hueti Pfr.

III. *Macularia* Alb. Mucus glands two or three-branched at ends; dart peculiar. Depressed species: mainly Italy, Sardinia and Corsica.

H. niciensis Fer., iv, 214.
nicæensis Rissor.,
v. faudensis Sulliotti.
v. clairi Bgt.
H. oberndoerferi Kob., iv, 217.
? *halmyris* Mab.
? v. tylota Westerl.
H. serpentina Fér., iv, 214.
v. isilensis (V.) Paul., iv, 215.
v. jaspidea Mab., iv, 215.
marmorellata Mab.
v. trica Paul.
v. velanicia Mab.
H. isaræ Paul., viii, 236.
H. magnetti Cantr., viii, 236.
hospitans Bon., Paul., iv, 215.
v. alabastrina Paul., iv, 216.
H. caræ Cantr., iv, 216.
v. orites Westerl.
v. adjaciensis Paul., iv, 216.
H. cenestinensis Cr. & Deb., iv, [216.
H. suburbana Paul., viii, 236.
H. pudiosa Paul., iv, 217.
v. austera W.
forsythi Kob. Icon., n. f., 508.
H. villica Paul., iv, 218.
H. tetrazona Jan., iv, 218.
picæna Tib., iv, 109.
f. ascoliensis Bgt.
H. strigata Müll., iv, 218.
f. posidoniensis Tib., iv, 219.
f. corrugata Z., Rm. *Icon.*, 229.
f polita Paul., iv, 219.
v. sicula Ben., 219.
v. umbrica Charp., iv, 218, 224.
f. moltenii Ad., West.
v. fuscolabiata Rm., iv, 219.
H. theresæ (Ben.) Mts., iv, 224.
H. surrentina Schm., iv, 218.
f. lucana Bl., West.
H. saxetana Paul., iv, 224.
H. mariannæ Kob., iv, 222.
circumornata Kob., *olim.*

v. peucetana Kob., iv, 122.
v. apula Bl., iv. 219.
H. forsythi Paul., iv, 223.
f. orta Paul., iv, 224.
H. argentarolæ Paul., iv, 223.
H. signata Fér., iv, 223.
circumornata Mts. not Fér.
ficuum Mühlf.
f. virginea Blanc.
H. scherzeri (Zel.) Pfr.
H. carsoliana Fér., iv, 219.
carseolana Auct.
marrucina Tib.
v. recondita West., iv, 220.
v. contaminata Paul., iv, 220.
v. uzielliana Paul., iv, 220.
v. persianii Tib., iv, 220.
v. uniarmata Paul., iv, 220.
v. milettiana Paul., iv, 220.
H. nebrodensis Prj., iv, 220.
v. silvestrii Cafici, iv, 226.

Section *Levantina* Kobelt, 1871.

Levantina Kob., Catal. Eur. Binnenconch., p. 19. See for anatomy Schmidt, Stylom., pl. 4, f. 21, and Schuberth, Arch. Naturg., 1892, pl. 5, f. 9, 10.

Shell solid, rather cretaceous, large and depressed, the earlier whorls acutely keeled, rendering the sutures rather superficial, last whorl wide, rounded, umbilicate or imperforate, ornamented with 4 or 5 bands of arrow-like spots, or unicolored whitish, deflexed in front. Aperture ovate-rounded, very oblique; lip expanded, the baso-columellar margin reflexed and dilated. Type *H. guttata.* (See pl. 44, figs. 1, 2, 3, *H. guttata var. sesteri.*)

Jaw with 4–6 ribs denticulating the margins. Radula with the middle cusp of the median and lateral teeth wide, about as long as basal plates, no side cusps. Marginals with a long bifid inner cusp and a small ectocone.

Genital system (pl. 61, fig. 10, *H. hierosolyma*) with penis and flagellum as usual in *Otala.* Dart sack rather small; mucus glands 3-branched. Spermatheca duct long, with a long diverticulum. Dart four-bladed.

Distribution, Island of Rhodes and Palestine to the Mesopotamian Desert and Persia.

The anatomy offers nothing separating this group from *Otala* or *Iberus,* but the characteristic shell and the distribution render it convenient to retain the group.

H. spiriplana Oliv., iv, 226.
v. malziana (Parr.) Pfr., iv, [227.
v. gallandi Bgt.
H. hierosolyma Boiss.
f. masadæ Tristr., iv, 227.
f. lithophaga Conr., iv, 228.
H. cæsareana Parr., iv, 227.
f. maxima Bgt.
f. carinata Bgt.
f. albidula Bgt.
f. nana Mouss.
v. globulosa Bgt.
H. werneri Rolle, viii, 236.
H. dschulfensis (Dub.) Bgt., iv, 228.
dschulfensii Dubois.
djulfensis Mouss.
H. guttata Oliv., iv, 228.
v. ergilensis Galland.
v. sesteri Gall.
v. michoniana Bgt., iv, 229.
baschkira Pfr.
H. mazenderanensis Nev., iv, 229.
H. kurdistana Parr., iv, 230.
H. ceratomma Pfr., iv, 231.
H. escheriana Mss., iv, 230.
f. diarbekirana Gall.
f. euthyomphala Gall.
H. bellardii Mouss., iv, 231.
f. occlusa Mouss.
H. ghilanica Mss., iv, 231.
H. urmiensis Naeg., viii, 237.
H. ninivita Gall., viii, 238.
H. lapithœnsis Rolle.
H. gertrudis Rolle.
H. chrysostomi Rolle.

Subgenus (?) PARACHLORÆA Sandberger.

Parachlorœa SANDB., Conch. Vorwelt., p. 292, type *H. coquandiana* Mathéron.

Shell imperforate, lens-shaped, acutely keeled. Last whorl deflexed in front. Aperture very oblique, angulate-oval, the margins remote; upper margin of lip slightly expanded, basal margin reflexed and appressed. Type *H. coquandiana* Math.

The type of this group is from the French "Palæotherium chalk" of Oligocene age, but similar forms are found in Eocene and in lower Miocene deposits. The group, whether rightly limited or not, is probably a side branch of the *Helix* phylum. For any one to connect it with *Chlorœa*, on account of the keel, seems unjustified in view of the vast variability of this character. The development of a keel in *Helix*, with the consequent modification of shell contour, is a character of the most trivial import. A few of these forms which I have seen, seemed to be keeled manifestations of the *Tachea* group.

Subgenus Eremina Pfeiffer, 1855.

Eremina Pfr., Mal. Bl., 1855, p. 139, sole species *H. desertorum.* —*Eremophila* Kobelt, Katalog Eur. Binnenconch., p. 19, 1871; Iconographie iv, p. 13.—*Erinna* Morch., Journ. de Conch., 1865, p. 387 (*desertorum*).—*Eremia* Auct.—*Conf.* Jickeli Moll. N.-O.-Afrika's, pl. 1, f. 7–9 (dentition, jaws and darts); Schuberth, Archiv f. Naturg., 1892, pl. 5, f. 11, 12 (teeth and dart).—Semper, Reisen im Arch. Phil. Landmoll., pl. 14, fig. 14 (genitalia).

Shell imperforate or narrowly umbilicate, *solid, chalky,* with rudely striate surface; white with reddish bands or suffused and streaked with tawny. Whorls about 5, the last somewhat or not descending. Aperture slightly oblique, wide lunate; lip a little expanded and blunt or greatly thickened, the columellar margin reflexed, *arcuate, not thickened by an internal plate* of callus. Type *H. desertorum* Forsk., pl. 44, figs. 12, 13; also fig. 14, var. *ehrenbergi* Roth, (*chilembia* Bgt.)

Jaw stout, arcuate, with blunt ends; having grouped near the middle two to four strong ribs dentating both margins (pl. 67, fig. 9, *H. desertorum;* fig. 8, *H. desertella*). Radula having basal plates rather short; cusp attaining edge of basal plate, the side cusps obsolete; laterals bicuspid, with a small outer cusp. Marginals having the larger cusp bifid, the ectocone also splitting on the outer ones (pl. 67, fig. 10, *H. desertorum*).

Genitalia: Spermatheca duct long (45 mill.) *with no diverticulum.* Dart sack small, containing a two-bladed dart with serrate crown, and a longitudinal rib or sometimes a blade on one or each side (pl. 63, fig. 6, *H. desertorum*). Mucus glands 2, *long pediceled,* branching into 5 to 6 fine tufted fingers. *No flagellum on penis,* the retractor and vas deferens terminal (pl. 63, fig. 4, *H. desertorum*).

The solid, cretaceous shell and lack of flagellum on the penis ally this group to *Euparypha;* the long-stalked pair of digitate mucus glands and the tendency to be five-banded are points of likeness to *Tachea.* The dart is slightly coronated at base, the head long and two-bladed, but with side ribs which sometimes develop into blades, and it, therefore, is mainly of the type common in Pentatænia. A diverticulum on spermatheca duct is wanting, but this feature varies greatly even among closely allied species.

The species are desert forms, inhabiting northeastern Africa.

H. desertorum Forsk., iv, 127, H. desertorum.

[261. v. hasselquisti Ehr.
maculosa Born. *f.* ehrenbergi Roth.
irregularis Fér. *chilembia* Bgt.
forskalii Ehr. v. hemprichi Ehr.
arabica Roth. v. aschersoni Reinh.
psamitus Bgt. H. desertella Jick., iv, 127.
gemellarii Ben. H. duroi Hid., iv, 128.
rhodia Chemn. *f.* minor Kob., iv, 261.
depressa Mts. *haploa* West.
pachytoichea West.
kobelti West.
dillwyniana Pfr.

Subgenus EUPARYPHA Hartmann, 1842.

Euparypha HARTM., Erd.- u. Süsswasser Gasterop. Schw., p. 204, for *H. rhodostoma* =*pisana*.—*Conf.* for anatomy, SCHMIDT, Stylommat., p. 22 pl. 5, f. 23; MOQ.-TAND., Moll. Fr,, p. 259, pl. 19, f. 9–19, SCHUBERTH, Arch. f. Naturg., 1892, p. 55, pl. 6, f. 1–3.

Shell narrowly umbilicate or subimperforate, *compact, solid, cretaceous*, subglobose or depressed and keeled, white or light, usually decorated with *many dark irregularly placed bands and lines*. Surface striated, *the striæ decussated by spiral incised lines*, at least on the spire. Suture superficial; last whorl descending or straight; aperture little oblique, lunate, *the lip sharp, not expanded*, thickened by an internal callus rib, columellar end triangularly reflexed. Type *H. pisana*, pl. 43, figs. 37, 38.

Jaw well arched, with two or three strong ribs denticulating both margins. Radula as in Pentatænia, Helicigona, etc.; the middle cusp of middle tooth is longer than the short, square basal plate, side cusps small; laterals similar but without inner cusp, outer cusp larger; marginals with a long bifid inner cusp and smaller outer cusp, the latter split on the outer teeth.

Genital system (pl. 61, figs. 1, 2, 3, 4, 5, *H. pisana*) characterized by *the lack of flagellum* on penis, the retractor and vas deferens terminal; spermatheca duct long, without a diverticulum (or according to Schmidt with a short one); *mucus glands two, long, simple* and tubular. Dart sack small, containing a straight, *four-edged, coronated dart* (fig. 2, 4, 5) like that of *Tachea splendida*.

Distribution, Mediterranean region, Canary Is., Madeira, etc.; *H. pisana* extending to southern England and throughout the whole range of the genus. *H. macandrewiana* is confined to the tiny Atlantic Islands known as the Salvages; *H. impugnata* and the beautiful varieties *geminata, grasseti, hierophanta* of *H. pisana,* are Canarian.

The cretaceous, many-banded shell, with non expanded, inwardly thickened lip, is more like that of *Helicella* than the Pentatæniates; and the lack of a flagellum is also a strong differential feature, allying *Euparypha* to *Eremina.*

The single dart sack with its four-sided dart is a structure characteristic of the five-banded group; and the right eye retractor passes between the branches of the genitalia, as in normal Helices; these features at once removing *Euparypha* trom the Xerophiloid stock. The simplicity of the two mucus glands is a character in common with *Helicigona* and *Iberus;* and evidently represents an earlier stage of development than the digitate type, which has been retained in these groups. I suppose the lack of flagellum to be a degenerative change. *Euparypha* is, therefore, a curious mixture, the mucous glands being of antique character, the male organs degenerate, and the dart modernized. Teeth and jaw offer nothing characteristic.

H. pisana, the typical species, is an abundant snail from northern Africa to southern England and the Atlantic islands. It has been split by "new school" authors into a multitude of alleged species, some of which may prove worth retention as local varieties. The principal names are as follows: *thusuroi, subpisana* Bgt., *brysæ, radesiana* (Marès) Bgt., *chambardi, salemensis, gergisensis, carpiensis, hamadanica, djerbanica, zitanensis* Let. & Bgt., *maculata* Mke., *anonyma* W., *donatii, levesquei* (Berth.) Bgt., *pisanella, pisanopsis, dermoi* Serv. Other synonyms are *zonaria* Penn., *petholata* Oliv. *rhodostoma* Dr., *cigenda* Mont., *strigata* Dillw., *leucostoma* Risso, and doubtful varieties are *perruginea,* Mke., *punctella* M.-T., *subzonata* Bgt., *sigarellina* Charp., *alboranensis* (Webb. & Berth.) Mab. (not Pfr. et Auct.), *catocyphia* Bgt., iii, 256, *hyperplatæa* Serv., etc.; etc.

H. macandrewiana Pfr., iii, 224.
ustulata Lwe.
H. pisana Müll., iii, 224.
? decorata Pfr., iii, 225.
v. pisanopsis Serv., iii, 225.
v. aegusæ Kob., iii, 225.
v. sardoa Ziegl., iii, 224.
v. graphica Morel.

æstivalis Bgt.
v. geminata Mouss., iii, 224.
alboranensis Pfr., iii, 224.
v. hierophanta Mab., iii, 225.
v. grasseti Tarn., iii, 225.
pisanoides Orb.
H. impugnata Mouss., iii, 226.
festiva Lwe., *Mss.*
v. subgeminata Mouss.
H. planata Chemn., iii, 226.
helicella Wood.
v. arietina Rossm.
v. erythrostoma Ph.
calliostoma A. & R.
H. dehnei Rm., iii, 225.
epiglottidea Bk.
f. erythronixia Bgt.
f. thlipsa West.
H. subdentata Fér. iii, 226.
subcarinata Mke.
cinæ Kl.
H. pisaniformis Bgt., iii, 227.
H. comaliana Bgt., iii, 227.
v. tiani Bgt., iii, 227.
v. tohenica Bgt., iii, 227.

ADDITIONS AND CORRECTIONS.

Genus TROCHOMORPHA (p. 1).

To species of first group on page 4, add:

T. horiomphala Pfr., iv, 51. T. cathcartæ Reeve, iv, 51.

From list of Philippine I. species omit *T. conomphala* Pfr., which is a young *Obba parmula, teste* Ponsonby *in litt.*, and *T. radula* Pfr. a species of *Bensonia*; and add:

T. crassula Mlldff.
T. pseudosericina Mlldff.
T. morongensis Mlldff.
T. alticola Mlldff.
T. schmackeri Mlldff.
T. intermedia Mlldff.
T. gracilis Mlldff.
T. suturalis Mlldff.
T. heptagyra Mlldff.
T. sericina Mlldff.
T. splendidula v. carinaria Mlldff.
T. boholensis Semper.

Möllendorff (Ber. Senck. Nat. Ges. 1893, p. 74) considers the well-distinguished local races *sibuyanica* Hid., *boettgeri* Mlldff., with *quadrasi* Hid. as referable to *metcalfei* Pfr. if it be advisable to understand the species in such wide limits. Is *Tr. stenozona* Mlldff., mentioned as a new species from Luzon, but still undescribed, in Ber. Senck. Ges. 1890, p. 213, another form of this species?

T. natunensis Smith, Ann. Mag. N. H. '94, 455. Natuna Is.
T. partunda (not "partunga," p. 5) Angas.
T. hidalgoana Crosse (p. 6) is reported by Brazier from N. Georgia, Solomon Is.

Genus PUNCTUM Morse (p. 6).

Add: P. massoti Bgt., iii, 29, shown by Pollonera to belong here.

Genus LAOMA Gray (p. 8).

Add the following species described in Trans. N. Z. Inst. xxvi.

L. ciliata Suter.

And to section *Phrixgnathus*, these from New Zealand:

L. murdochi Suter. L. cheesemani Suter.

And the following from Tasmania: (see Ann. Mag. N. H., Jan., 1894, p. 64).

L. weldii Tenison-Woods. L. pipaensis Petterd.
L. furneauxensis Petterd. L. halli Cox.
L. hobarti Cox.

Genus FLAMMULINA Mart. (p. 10).

Suter in Ann. Mag. Nat. Hist. Jan., 1894, p. 64, gives a classification of Tasmanian Flammulinas from the examination of the dentition, as follows:

Sect.: *Flammulina:* F. jungermanniæ Pett., sitiens Cox, luckmanni Braz.

Sect.: *Gerontia:* F. albanensis Cox, stanleyensis Pett., legrandi Cox, marchiannæ Cox, diemenensis Cox, gadensis Cox, tasmaniæ Cox, subrugosa Braz., mathinnæ Pett., macdonaldi Cox, bassi Braz., tamarensis Pett.

Sect.: *Phacussa:* F. savesi Pett., stephensi Cox, hamiltoni Cox.

Sect.: *Allodiscus*: F. limula Cox.

Sect.: *Thalassohelix*: F. fordei Braz.

Some of these may prove to be Charopas, however.

P. 13, add after *tranquilla* Cox, iii, 26. After hamiltoni Cox, iii, 87. *cœpta* Cox should stand cœpta.

Section *Allodiscus* Pils. (p. 14).

F. smithi Suter, Tr. N. Z. Inst. xxvi. F. rustica Suter, *t. c.* p. 135.

Section *Pyrrha* Hutt. (p. 15).

F. subincarnata Suter, Tr. N. Z. Inst., xxvi, p. 133.

Section *Phenacohelix* Sut. (p. 16).

F. pilula v. unicolor Suter, Tr. N. Z. Inst. xxvi, p. 134.

Section *Flammulina* Mart. (p. 18).

The species *novaræ* proves to belong to *Zonitidæ*, and should be removed from list on p. 18.

F. pilsbryi Suter, Tr. N. Z. Inst., xxvi, p. 133.

Section *Carthæa* Hutton, 1884.

Carthæa Hutton, Trans. N. Z. Inst., xvi, p. 189, type *H. kivi*.

These smooth, subtrochiform shells, with conspicuously streaked color-pattern, prove to belong to *Flammulina*, the typical species having been investigated by Mr. Suter. *F. kivi* is from New Zealand, *flosculus* from Norfolk Island.

F. kivi Gray, iii, 37.
irradiata Gld.
radiaria Pfr.

F. flosculus Cox, viii, 77.

Genus ENDODONTA Alb. (p. 20).

P. 24. *E. sculptilis* Pease should be a synonym under *E. fratercula* Pse. the former name being preoccupied in *Helix*. On p. 27 add iii, 39, after *E. lamellicosta* Garrett. Add to list:

E. mariannarum Quadr. & Mlldff., Nachr. D. M. Ges. 1894, p. 14.
E. heptaptycha Quadr. & Mlldff., Nachr. D. M. Ges. 1894, p. 15.

Mr. Suter in Proc. Linn. Soc. N. S. Wales, viii, p. 494, adopts the etymology "hunnaensis" for *E.* (*Ptychodon*) *hunuaensis* of his several previous publications. As I do not find the Hunua or Hunna Range on the maps accessible to me, I do not know which spelling is correct.

Add on p. 28 these from St. Helena (Conchologist ii, pp. 164, 165):

E. sexdentata Smith.

E. perarmata Smith.

Section *Charopa* Alb.

On p. 31, "Pterotropis" was a pen-error for *Pterodiscus*.

Omit "E. raricostata" from list on p. 33; place *E. coma* var. *beta* as a synonym under *v.* globosa Suter; add after *E. ostiolum* Cr., ii, 180. *E. serpentinula* Suter is a variety of *buccinella* Rve. *E. mutabilis* Suter is a synonym of *tau* Pfr.

E. anguiculus Reeve (p. 32).
v. montivaga and v. fuscosa Sut.

E. pseudocoma Suter.

Add the following Marianne and Natuna Island species of *Charopa*, Nachr. D. M. Ges. 1894, p. 13, 14:

E. fusca Quadr. & Mlldff. E. quadrasi Mlldff.
E. rotula Quadr. & Mlldff. E. persculpta Sm., Ann. Mag. '94.

The *Helix* (*Helicella*) *australis* of Menke, from Mt. Eliza, Swan River, may possibly belong to *Charopa* if it is really Australian; but it certainly does not look like one. See vol. iii, p. 103.

On p. 33, *E. microscopica* Cox (not Krauss) must be dropped in favor of *E. microcosmos* Cox.

On p. 34, E. "cupera" Cox=*cuprea*. For "retepora" and "reteporoides," read *retipora* and *retiporoides*.

Genus PHASIS Alb., and *Trachycystis* Pils. (p. 37).

Suter (Ann. Mag. N. H. 1894, p. 60) believes a caudal pore to be present in *Pella burnupi*, the dentition of which he figures. None was visible in the badly preserved specimens of *P. rariplicata* examined by me. On p. 39 the following corrections should be made:

P. inclara Morel. P. zanguebarica Crav., iii, 105.
H. inops Morel. not Mouss.

Genus SCULPTARIA (p. 39).

Possibly this may prove to be a genus of Protogona. Ponsonby writes that Ancey's *S. chapmanni* (subsequently changed to *S. melvilliana*, Brit. Nat. 1892, p. 126) has been compared with the type of *damarensis* H. Ad., and found to be absolutely the same.

Genus AMPHIDOXA (p. 41).

A. chiliensis Muhl. (not *chilensis*).
A. tenuistria Phil. (not *tenuistriata*).

Genus PYRAMIDULA (p. 42).

Section *Microconus* Strebel & Pfeffer, 1880.

Microconus Strebel & Pfeffer, Beitr. Mex. Land- und Süsswasser-Conchyl. iv, p. 29, type *M. wilhelmi* Pfr.

This name is proposed for a small species of eastern Mexico resembling *Pyramidula rupestris* in contour, but ribbed as in *P. rotundata* or *perspectiva*. It can hardly be regarded as more than a "section" of *Pyramidula*. The position of *hermanni* and *mazatlanica* is doubtful.

P. wilhelmi Pfr., iii, 53. P. hermanni Pfr., iii, 22.
P. mazatlanica Pfr., ii, 204.

Section *Patulastra* Pfr. (44).

P. massoti Bgt. has been shown to be a *Punctum*. *P. luseana* Paiva becomes a synonym of *P. placida* Shuttl., an earlier name. The name *luseana* is repeated by error at foot of p. 47. *P. tenuicostata* Shuttl. being preoccupied in Helix, Servain calls the species *shuttleworthi*.

Section *Gonyodiscus* (p. 45).

Add to list of species, p. 47, the following Palæarctic forms:

P. machadoi Milne-Edw.
rotundata Morel.
v. azorica Mouss.
P. scutula Shuttlw.
P. omalisiana Bgt.
omalisma, err. typ., p. 47.
P. putrescens Lowe.
P. ganoda Mabille.
P. kompsa Mabille.
concinna Lwe. not Jeffr.
P. rotundata Müll.
v. infracostata Westerl.
abietina Paul., non Bgt.
P. chaperi West. Verh. k.-k. zoöl.-bot. Gesell. Wien. 1892, p. 27.

Section *Lyrodiscus* (p. 48).

The type of this group is believed by Wollaston to be a Zonitid. This is not unlikely, but the shells before me are dull, and the animal is unknown.

Section *Lyrula* Wollaston, 1878.

Lyrula Wollaston, Testacea Atlantica p. 382, type *H. loweana*. Wollaston is disposed to class this elegant, spirally laciniate Patuloid snail with the Madeiran *H. lentiginosa*. The single species is from Lanzerote, Canary Is.

P. loweana Wollaston: (Not *lowei* Fér.)
torrefacta Lowe not C. B. Ad.
usurpans Furtado, iv, 40.

Section *Iulus* Woll., 1878,

This (preoccupied) name is proposed by Wollaston (Test. Atlant. p. 326) for the *Patula garachicoensis* Woll. (*H. agrestis* Lwe. *in litt.*), a minute form found in Tenerife, Canary Is. It is said to have relations with *P. putrescens* Lwe. of Palma, and *P. bertholdiana* Pfr., of the Cape Verdes. *P. garachicoensis* has not been figured, and I have seen no specimens. A variety *submarmorata* is described by Wollaston.

Genus PARARHYTIDA Anc. (p. 52).

Mr. T. D. A. Cockerell has called my attention to the fact that the name *Saissetia* (p. 53) is preoccupied in entomology (*Coccidæ*), see Zool. Rec. 1865, and Proc. Amer. Ent. Soc. 1893, p. 54. He proposes to call the molluscan group PLATYRHYTIDA, the species *saisseti* being its type.

Genus THYSANOPHORA.

P. 58, add to synonyms of *T. boothiana*, *H. mauriniana* Orb., (" *lavalleana* " on plate). The reference after *T. incrustata* should stand: ii, 204.

Genus POLYGYRA (p. 68).

Add to list on pp. 76, 77, P. thyroides v. pulchella Ckll., (Journ. of Conch. 1892, p. 39), and
P. sanburni W. G. Binn., iii, 145. Kingston, Idaho.

Genus POLYGRATIA (p. 81).

Cancel the sectional name *Entodina*, (p. 83) and the species *reyrei* Souv., as a radula received from Prof. Gwatkin proves it to belong to *Streptaxidæ*. The other species are quite different, and may as well be placed in *Systrophia*, from which they differ only in the parietal lamina.

Genus PLEURODONTA, Section *Isomeria* (p. 93).

P. meyeri Strubell, Conchyl. Cab., p. 693.

Genus CAMÆNA (p. 101).

C. stolidota Quadr. & Mlldff. Paragua, Philippines.

The radula of *C. cicatricosa* is figured on pl. 34, fig. 10, from a mount kindly lent me by Prof. Gwatkin.

Section *Pseudobba* Mlldff. (p. 105).

C. brunonis Kobelt, Conch. Cab., p. 681. Halmaheira,

Genus OBBA (p. 107).

Add *H. conomphala* Pfr. to synonymy of *O. parmula* (p. 109).

O. viridiflava Mlldff.
G. subhorizontalis Mlldff.
O. flavopicta Mlldff.
O. basidentata v. grandis Mlldff.
O. marginata v. nana Mlldff.
v. pallescens Mlldff.
O. moricandi v. radiata Mlldff.
O. scrobiculata v. conoidalis Mlldff.

Genus PLANISPIRA Beck (p. 110).

Add to species of *Cristigibba*, (p. 113).

P. parthenia Kobelt, Conch. Cab., pl. 200, f. 9,10.

And to list on p. 114, the following from W. Australia, Proc. Mal. Soc. i, p. 93.

P. bathurstensis Smith. P. gascoynensis Smith.

Genus CHLORITIS (p. 117).

Add these Australian species, which may belong in the preceding group:

C. millepunctata Smith. C. rectilabrum Smith.
v. cassiniensis Smith.

C. subsulcata Mlldff. Cuban, Calamianes Is.

C. latecostata Kobelt. C. (Sulcobasis?) djamnensis Kob.

C. buxina Heude. China.

Genus THERSITES (p. 125).

Section *Badistes* Gld. (p. 129).

Add below T. OSCARENSIS Cox (p. 131) the synonym *H.* (*Rhagada*) *inconvicta* Smith, Proc. Mal. Soc. i, p. 90. Add to T. DERBYI Cox (p. 131) the synonym *H.* (*Trachia*) *derbyana* Smith, *t. c.*, p. 92. And the following species, described in the same place, all from N. W. Australia:

T. obliquerugosa Smith. T. sykesi Smith.
T. prudhoensis Smith. T. imitata Smith.
T. burnerensis Smith. v. cassiniensis Smith.
T. montalivetensis Smith.

Subgenus RHAGADA (p. 135).

Smith in Proc. Malac. Soc. i, p. 89, suggests that *H. torulus* Fér. is the same as *reinga* Gray, and places *H. elachystoma* Mart. as a synonym under *richardsoni* Sm. He queries the subgeneric reference of *plectilis* and *carcharias*, but it seems to me unnecessarily, for the specimens of both examined by me are very close to typical *Rhagada*.

Genus PAPUINA (p. 136).

Col. Beddome writes me that *Helix plurizonata* Adams & Reeve, described evidently in error from Borneo, is really the same as *tomasinelliana* Tap.-Can. (p. 142) and *agnocheilus* Smith, which, therefore, become synonyms. Also that the "Group of P. antiqua" (p. 141) consists of one species, *antiqua*, of which the other names are synonyms. Add the following:

P. divaricata Kobelt. P. lintschuana Kobelt.

The latter much like *P. goldiei* Braz. (p. 141), and like that, of doubtful generic position.

Genus PLECTOPYLIS (p. 143).

P. quadrasi Mlldff. Nachr. 1893, p. 172.
P. azona Gredl., viii, 158. P. vallata Hde., viii, 158.

Genus PYROCHILUS (p. 154).

P. pyrostoma vars. lucernalis and nigrescens Kobelt.

Genus EPIPHRAGMOPHORA.

P. 197, for *petasensis* read *patasensis*.

Genus EULOTA (p. 200).

Add to Plectotropis, p. 209: E. luzonica Mlldff., Nachr. '94, p. 105.

Genus HELICOSTYLA (p. 216).

Col. Beddome (*in litt.*) informs me that *Cochlostyla belcheri* is a bleached *velata*; *C. andromache* is a color-variety of *polillensis*.

Another name for Orthostylus is BULINA Lesson, Illustr. de Zool. 1831, pl. 22, for *Helix* (*Bulina*) *rufogaster*. Perhaps it is meant for a spelling of *Bulimus*.

Genus LEUCOCHROA (p. 234).

Add: L. debeauxi v.hypophysa West., Verh. k.-k zool.-bot. Ges. Wien, '92, p. 26.

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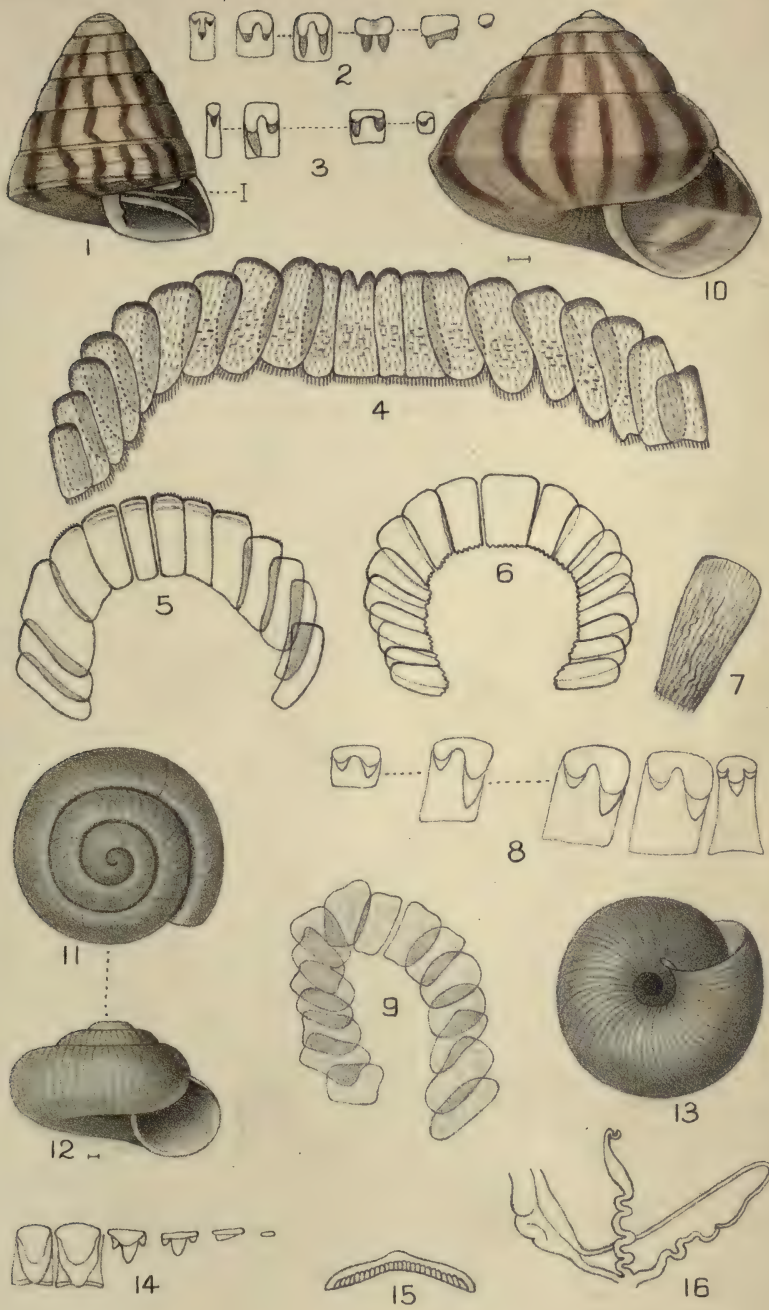
SUMMARY. This volume contains 561 figures, illustrating over 300 species of shells, and 571 figures illustrating the anatomy of Helices; a total of 1132 figures. Of these, 330 figures were drawn by the author; 203 other original figures were drawn by Messrs. Wm. and Edw. Shepperd, and about a dozen are from unpublished drawings supplied by friends. The figures of *Flammulina cressida*, *thaisa* and *costulata* Hutton, were drawn by Mr. H. Suter from the type specimens, these species being here for the first time illustrated. The figures of *Plectopylis ponsonbyi* (pl. 40, fig. 9–12), and *Papuina ianthe* (pl. 46, fig. 17–19) are from examples kindly loaned by Mr. John Ponsonby from his collection. The other original figures are from specimens in the collection of the Academy, where also most of the author's dissections—over 500 in number—are preserved.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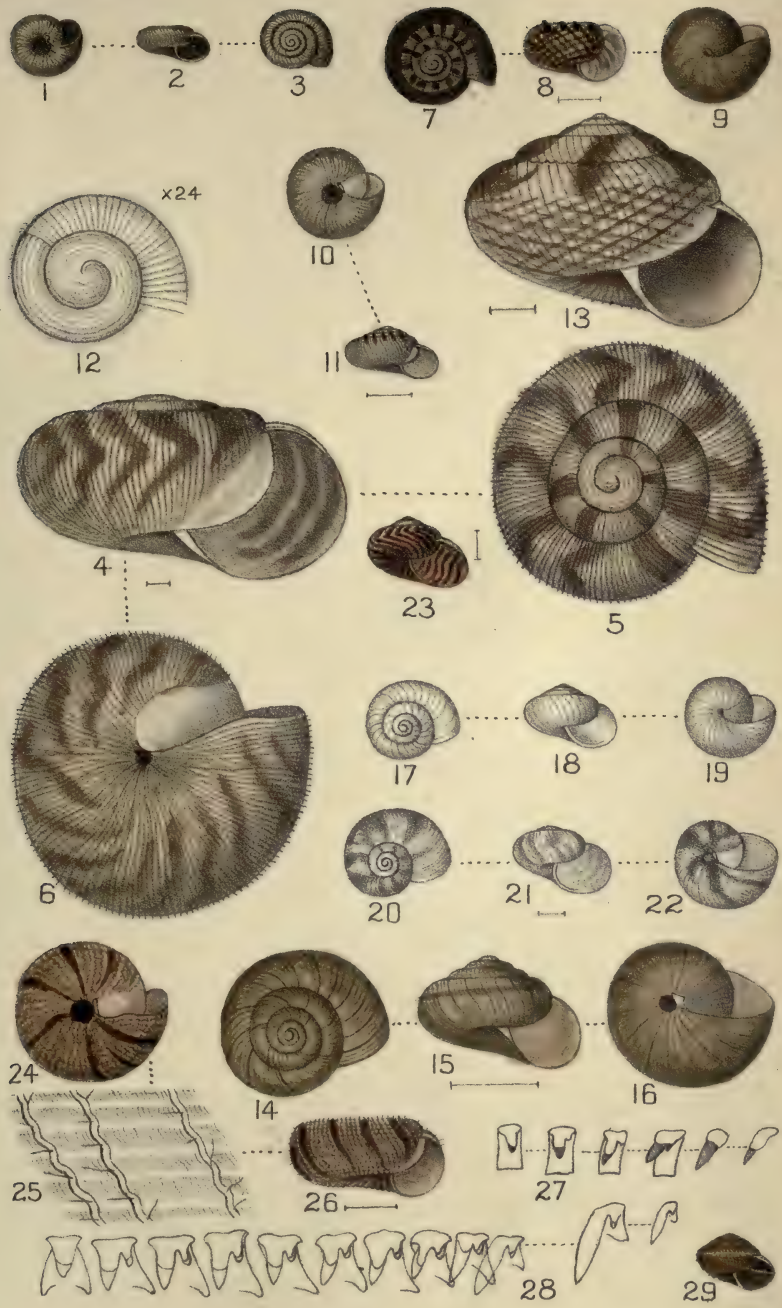
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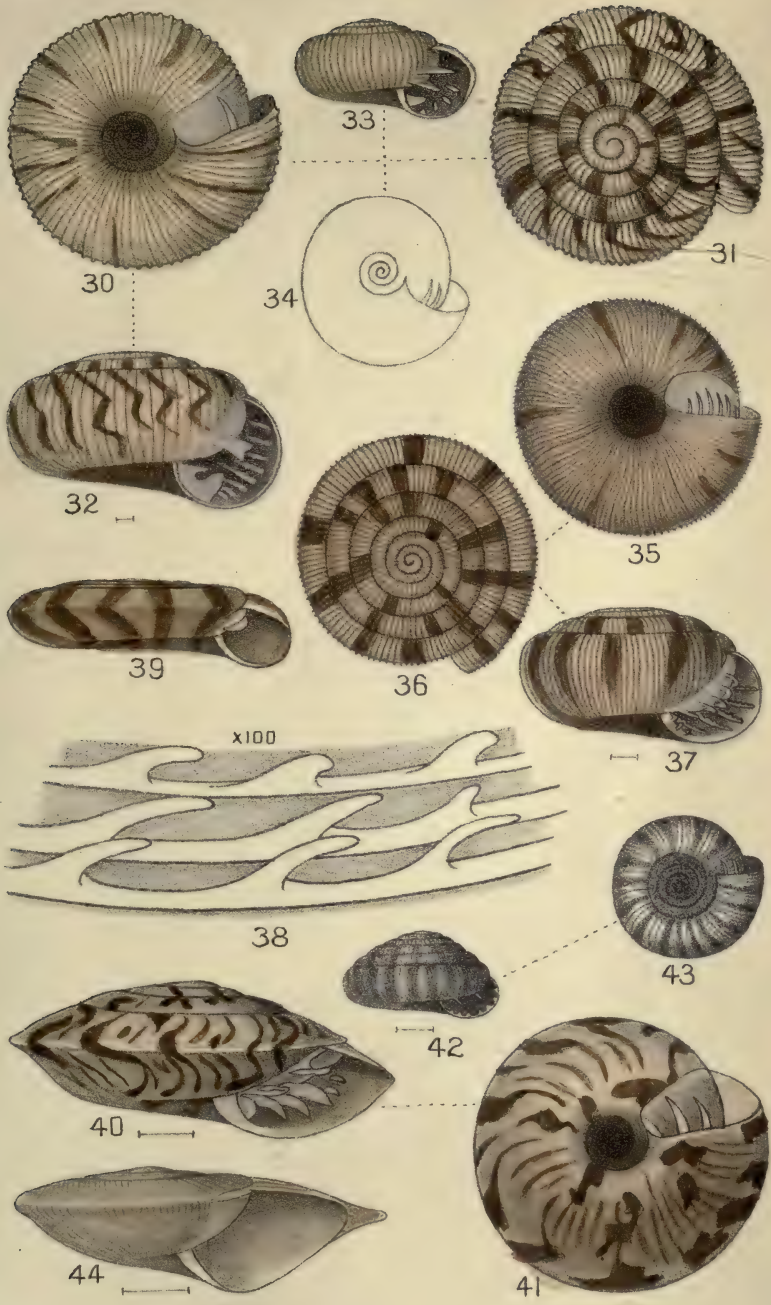
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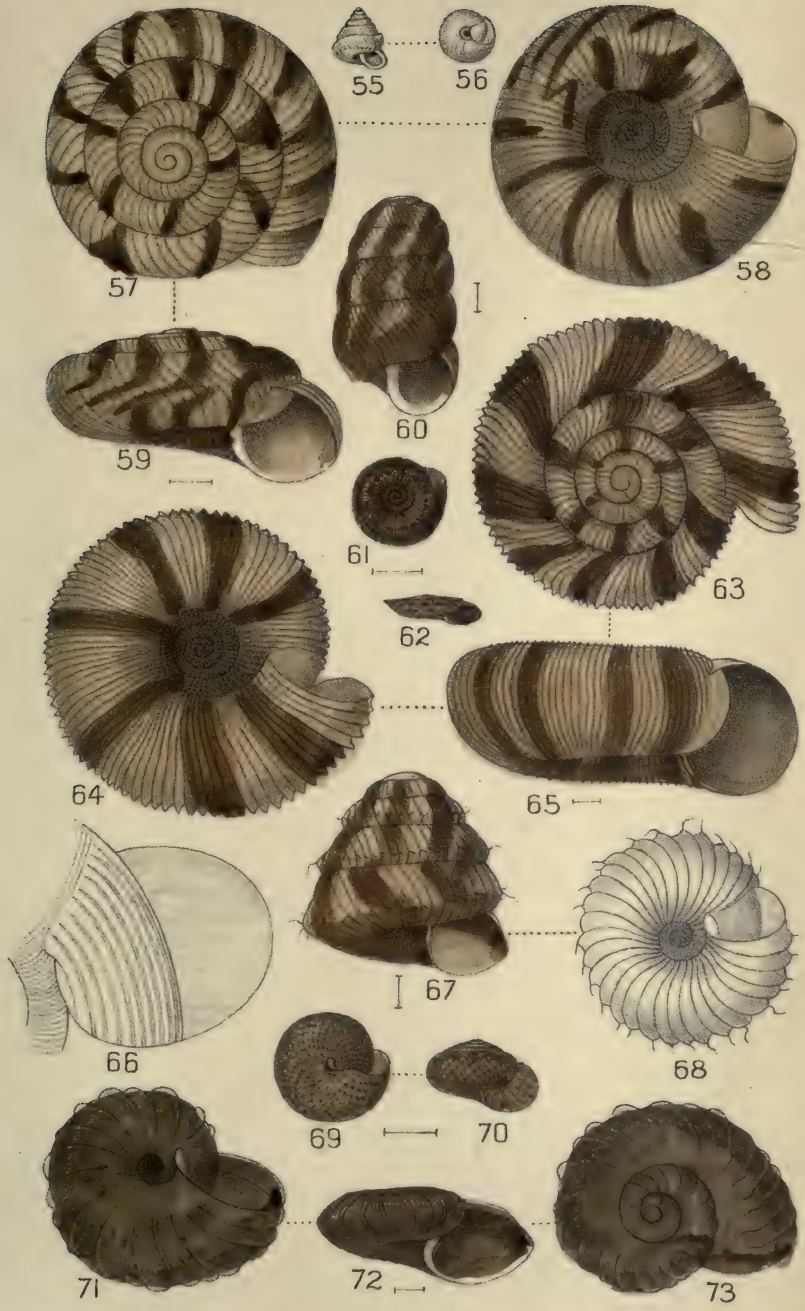
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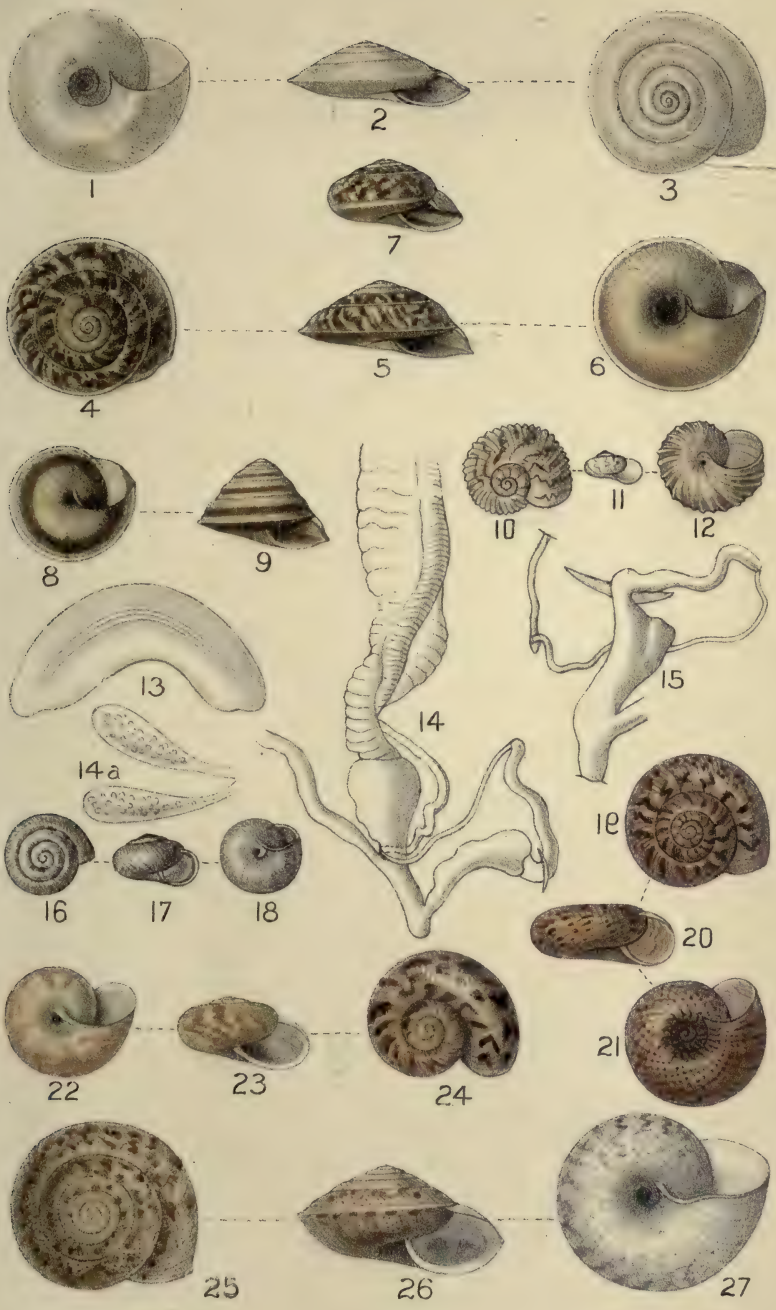
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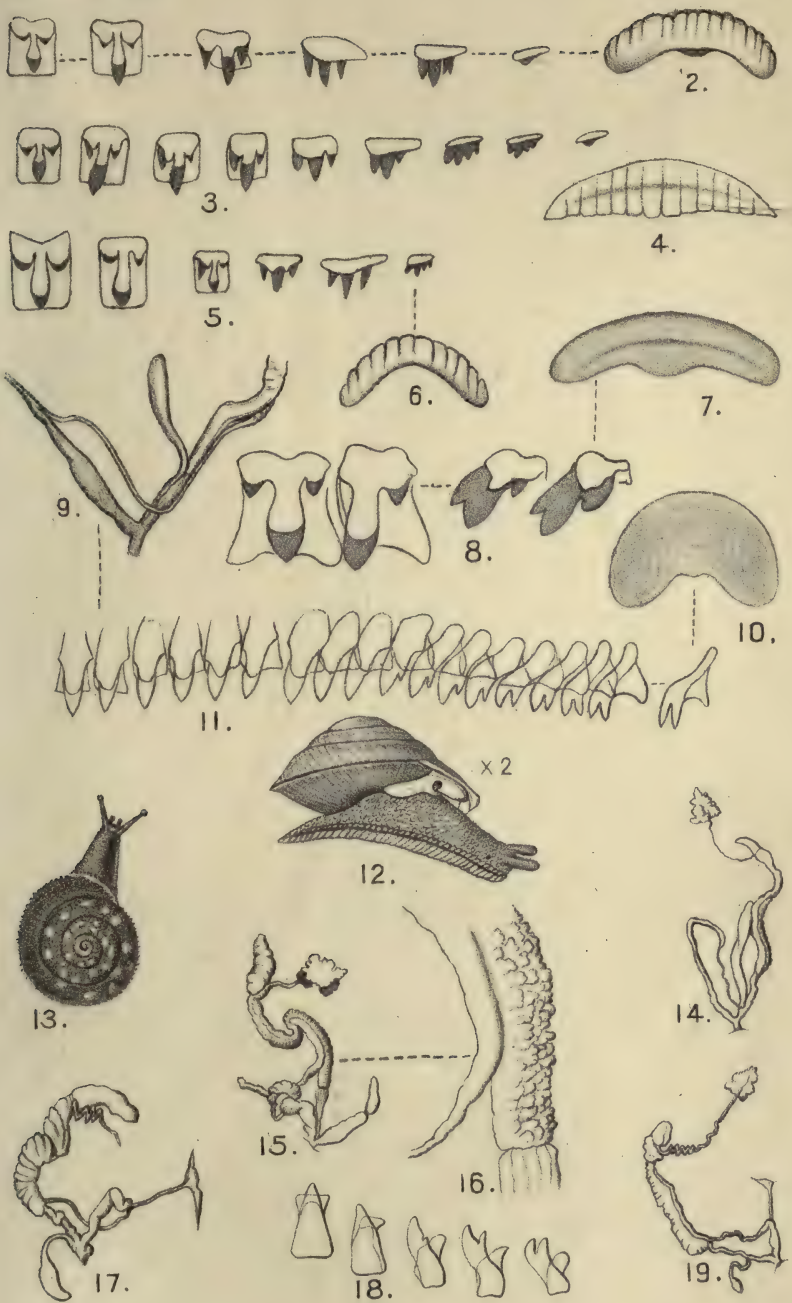
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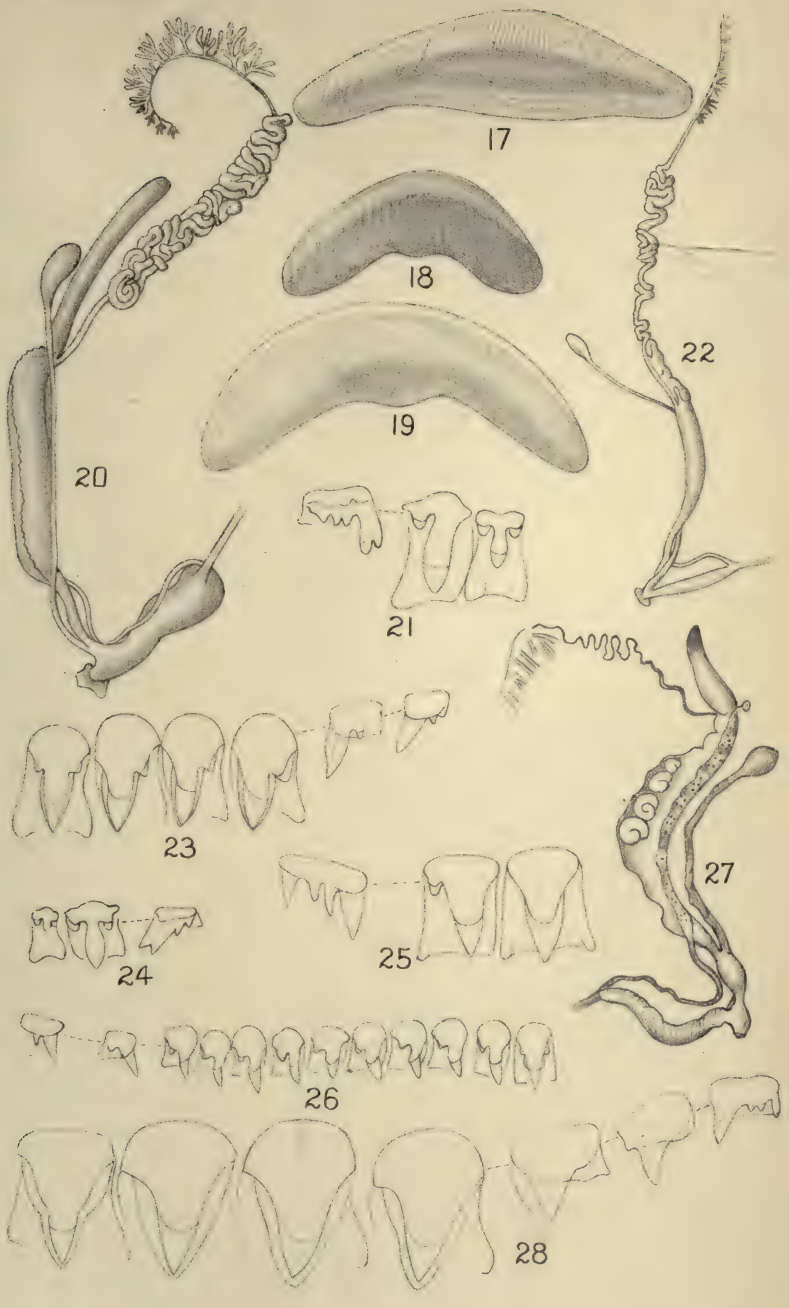
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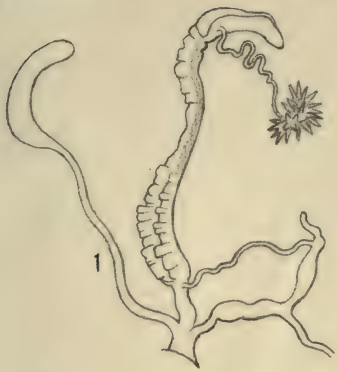
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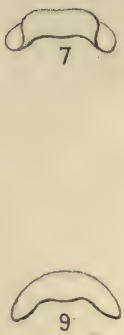
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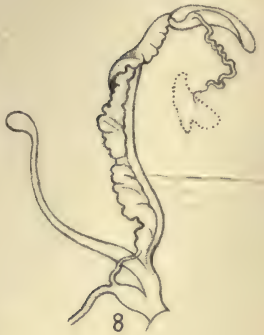
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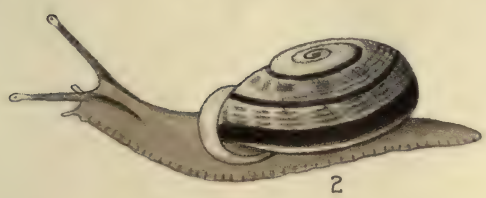
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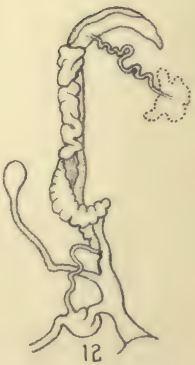
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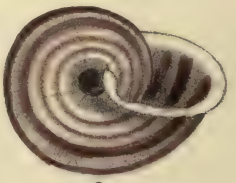
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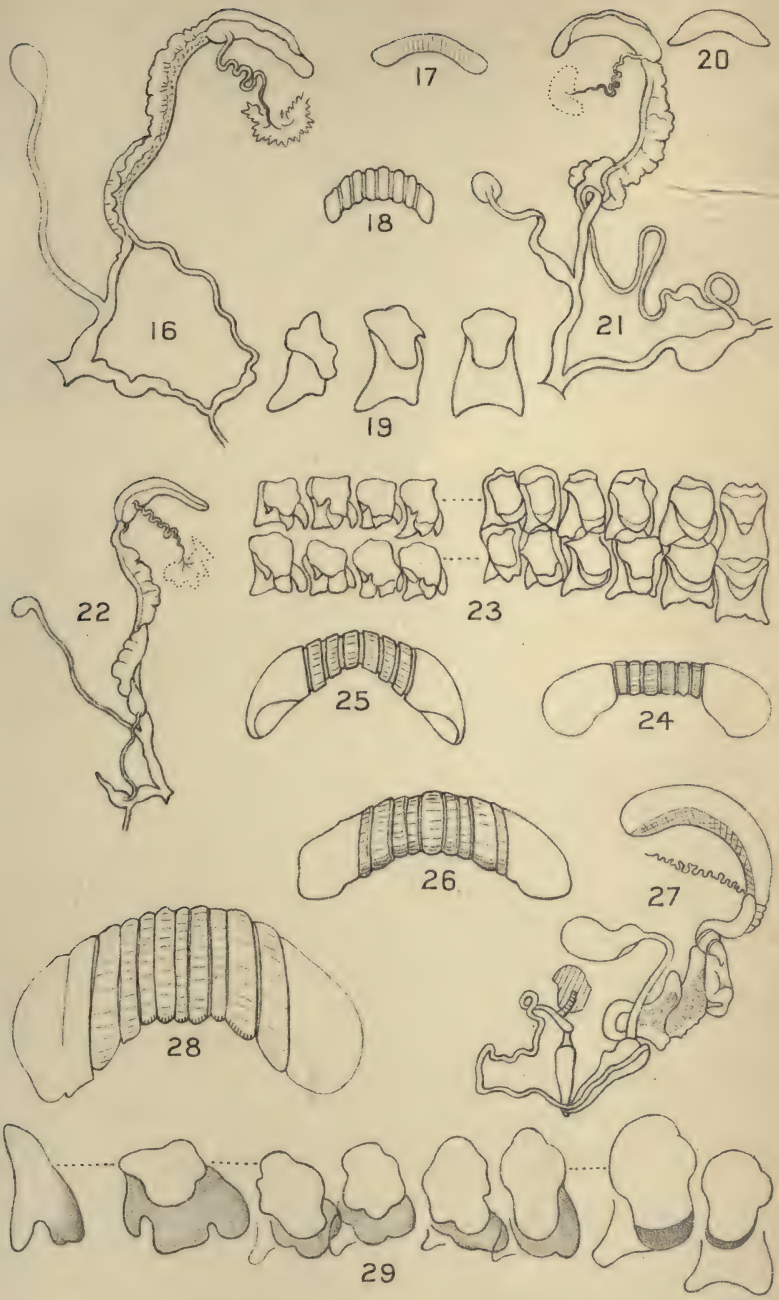
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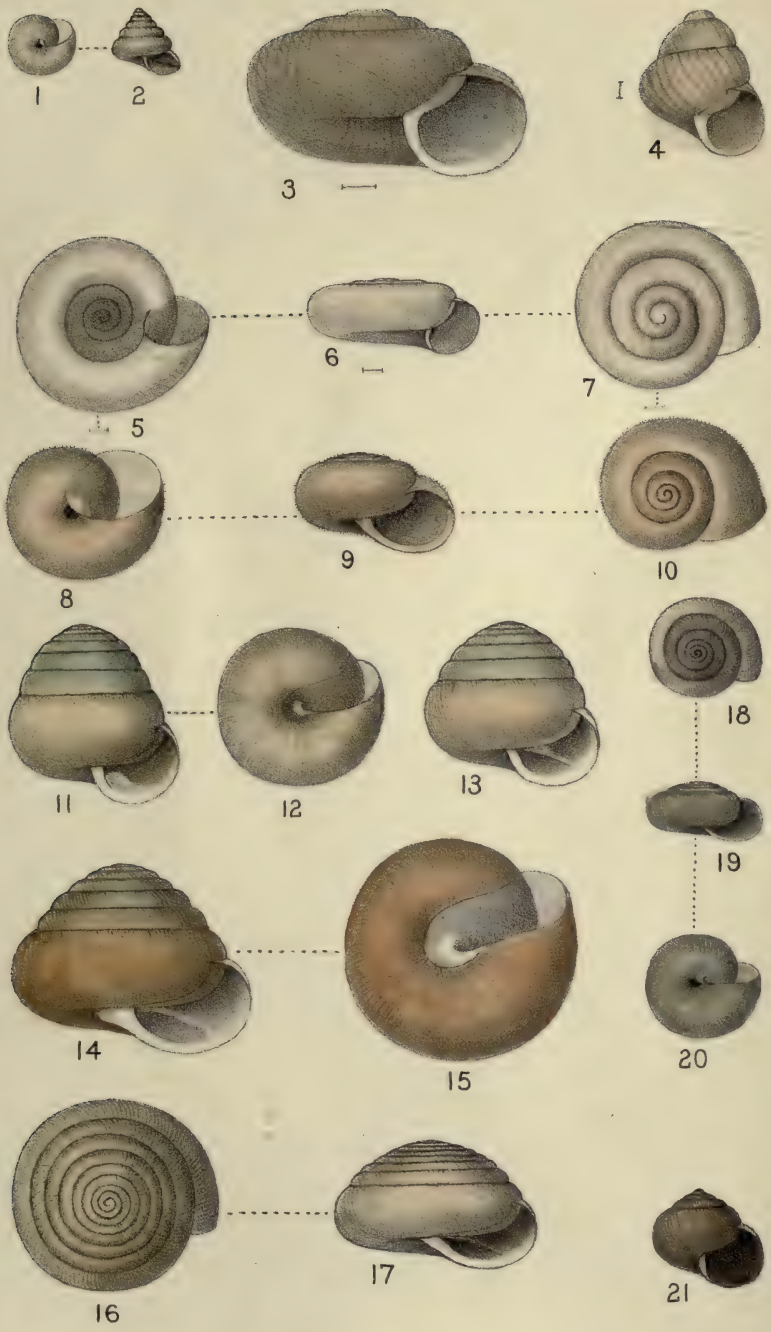
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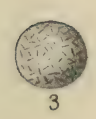
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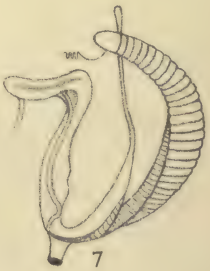
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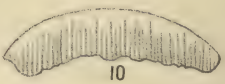
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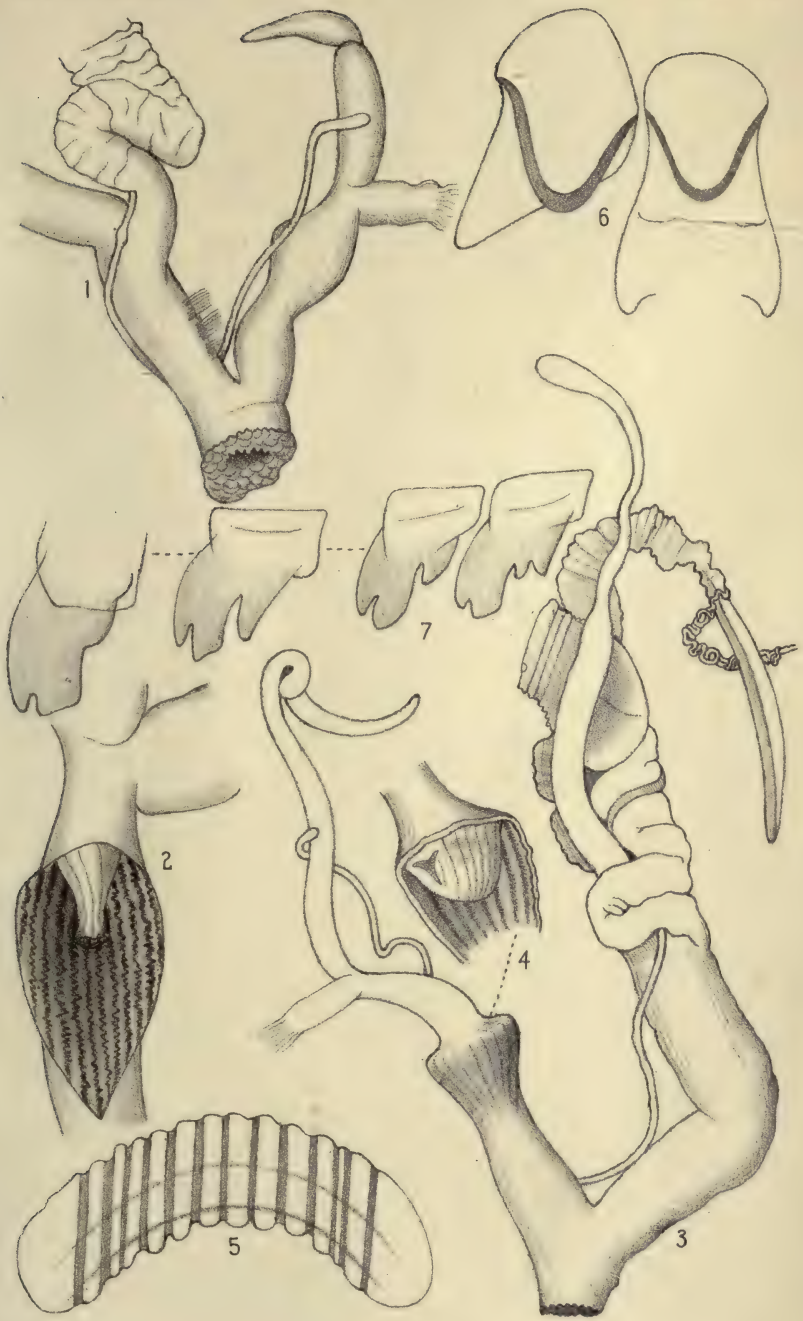
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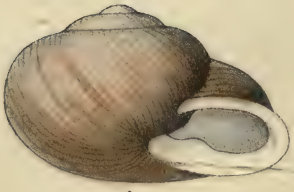
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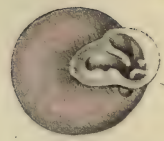
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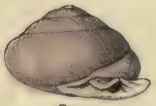
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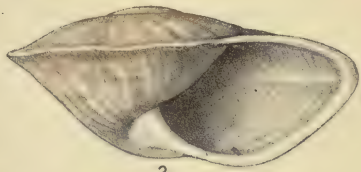
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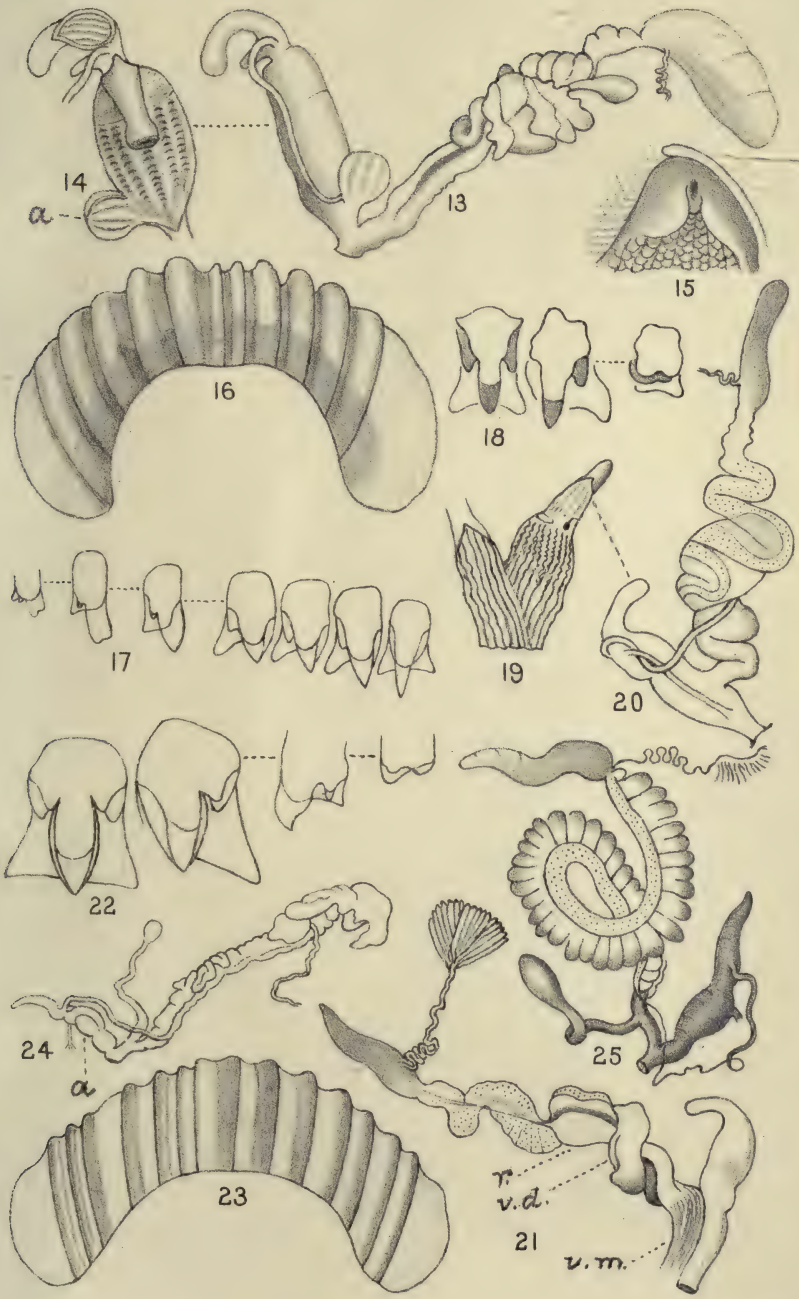
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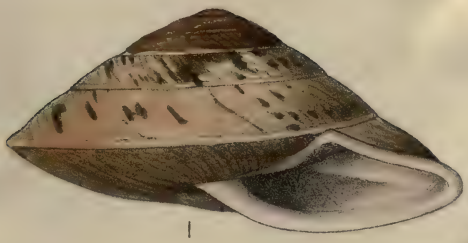
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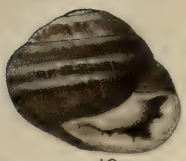
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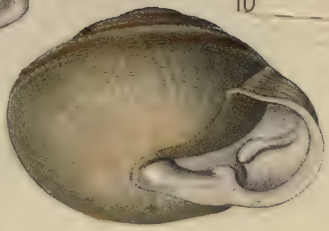
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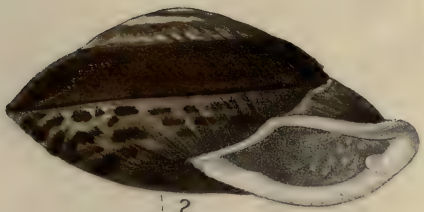
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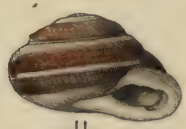
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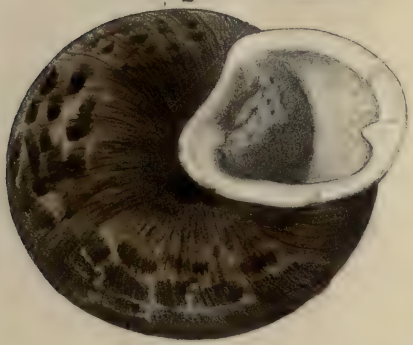
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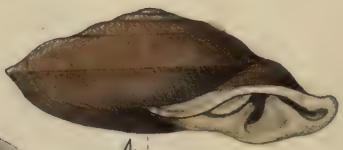
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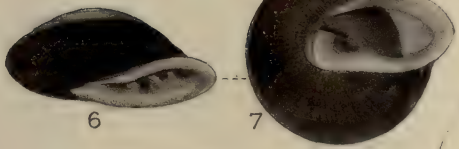
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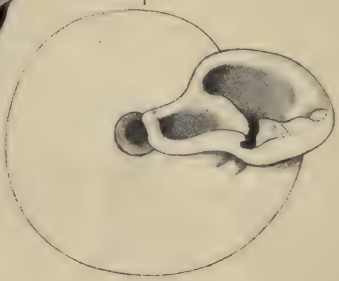
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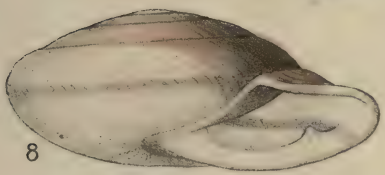
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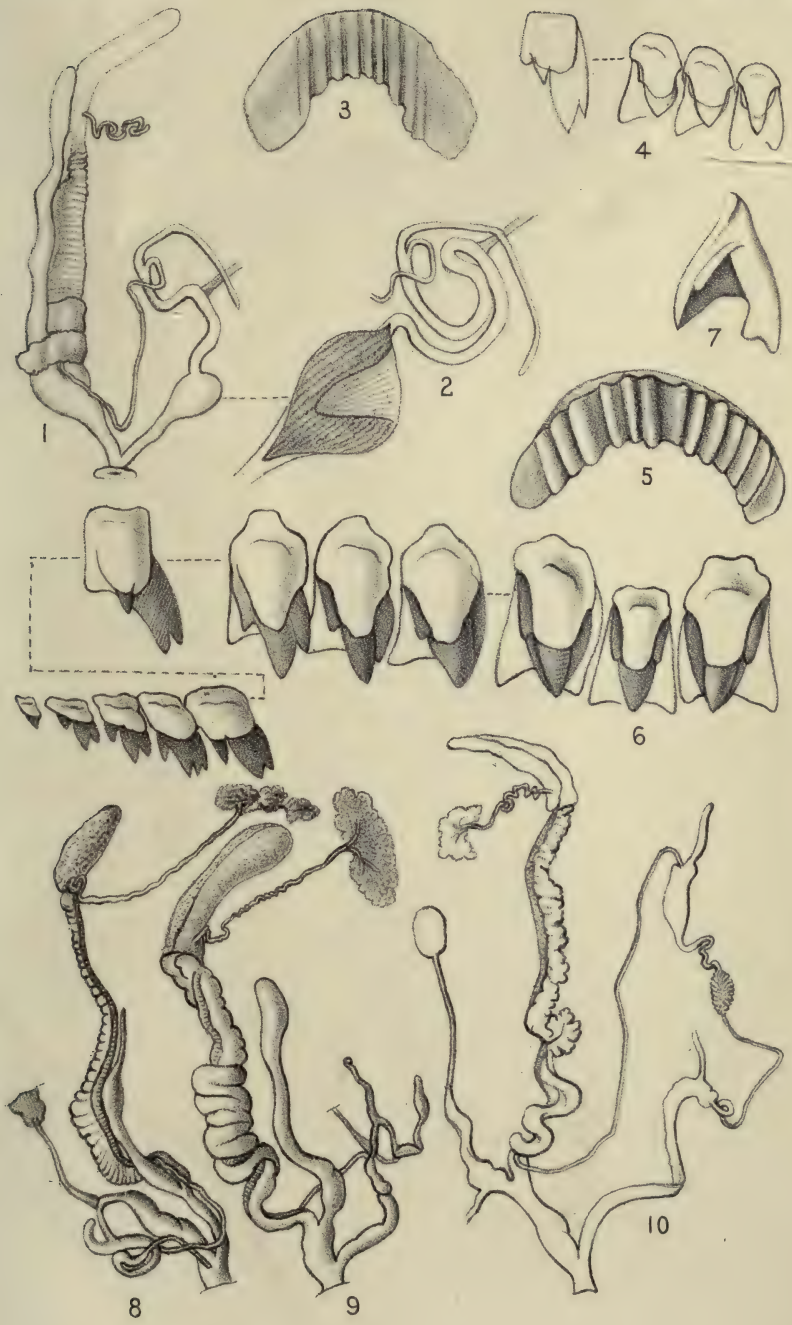
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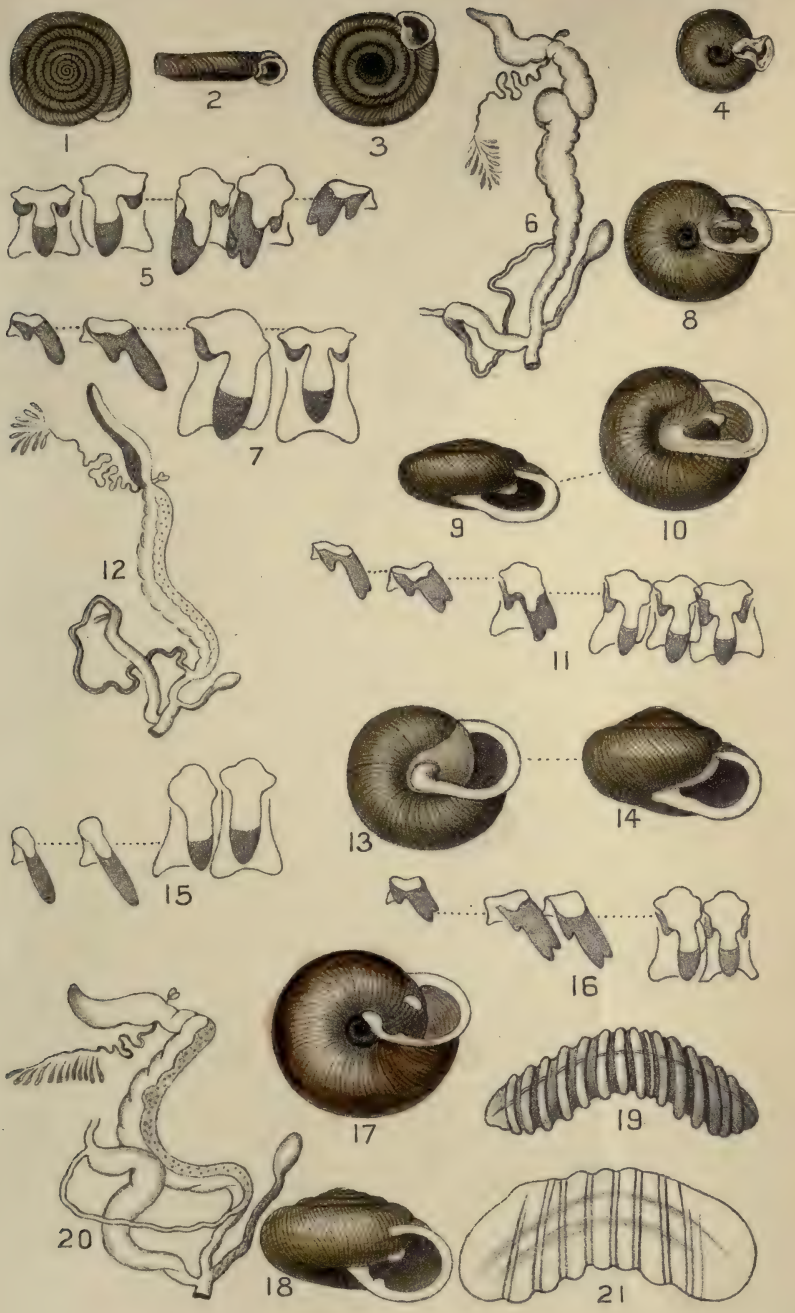
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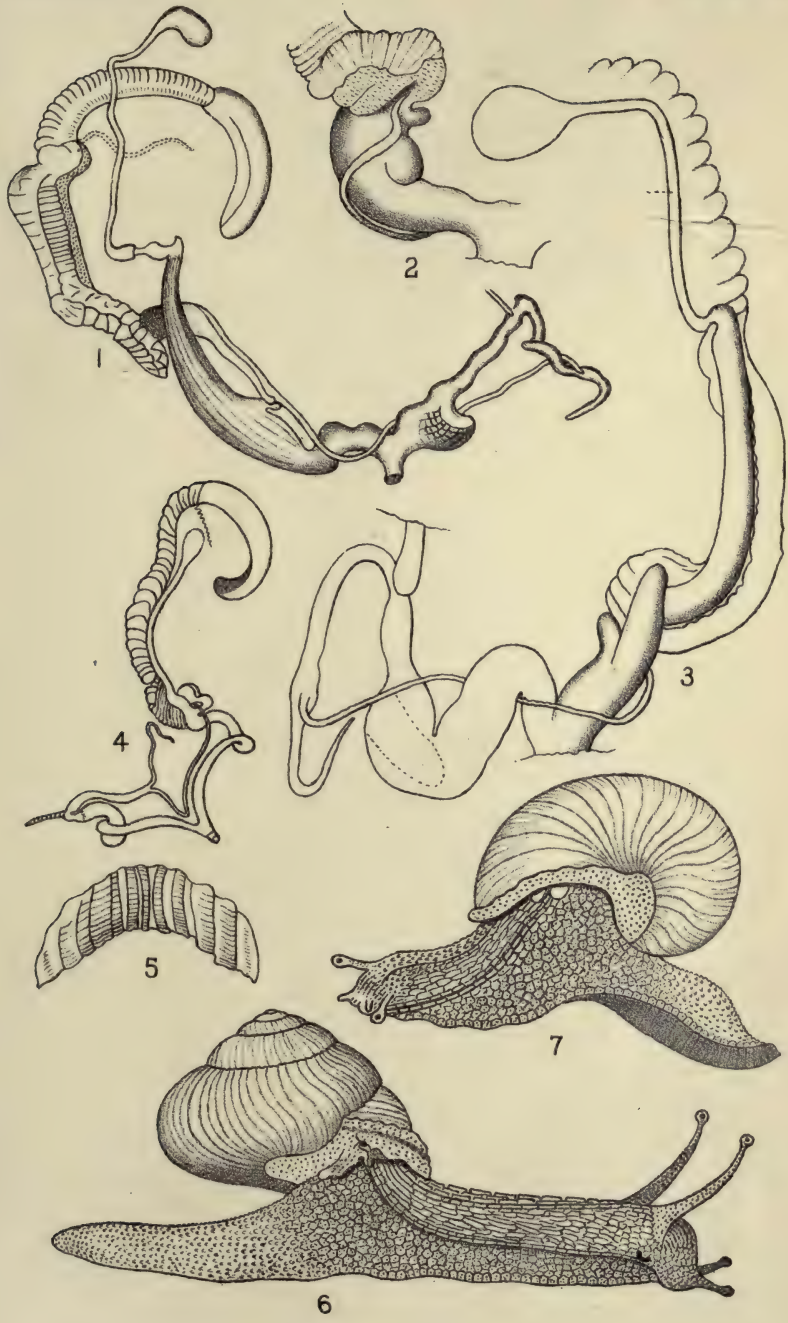
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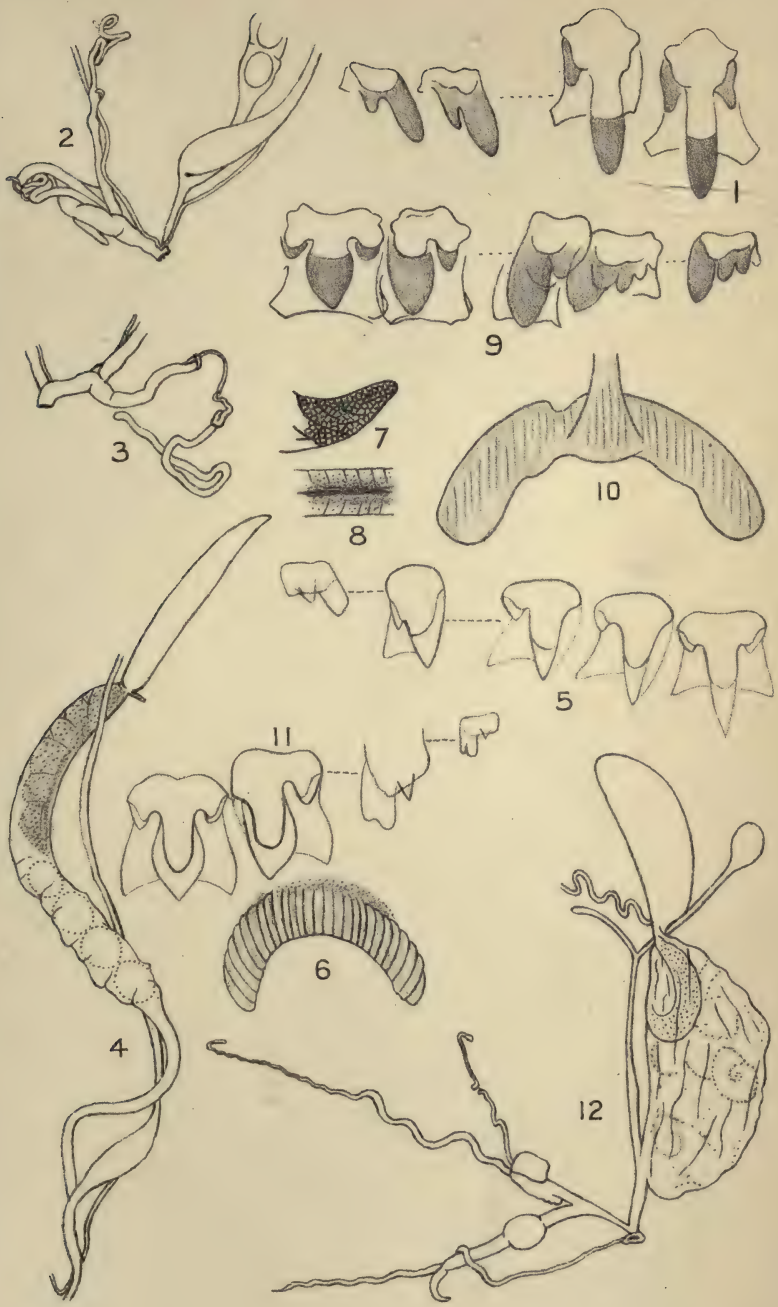
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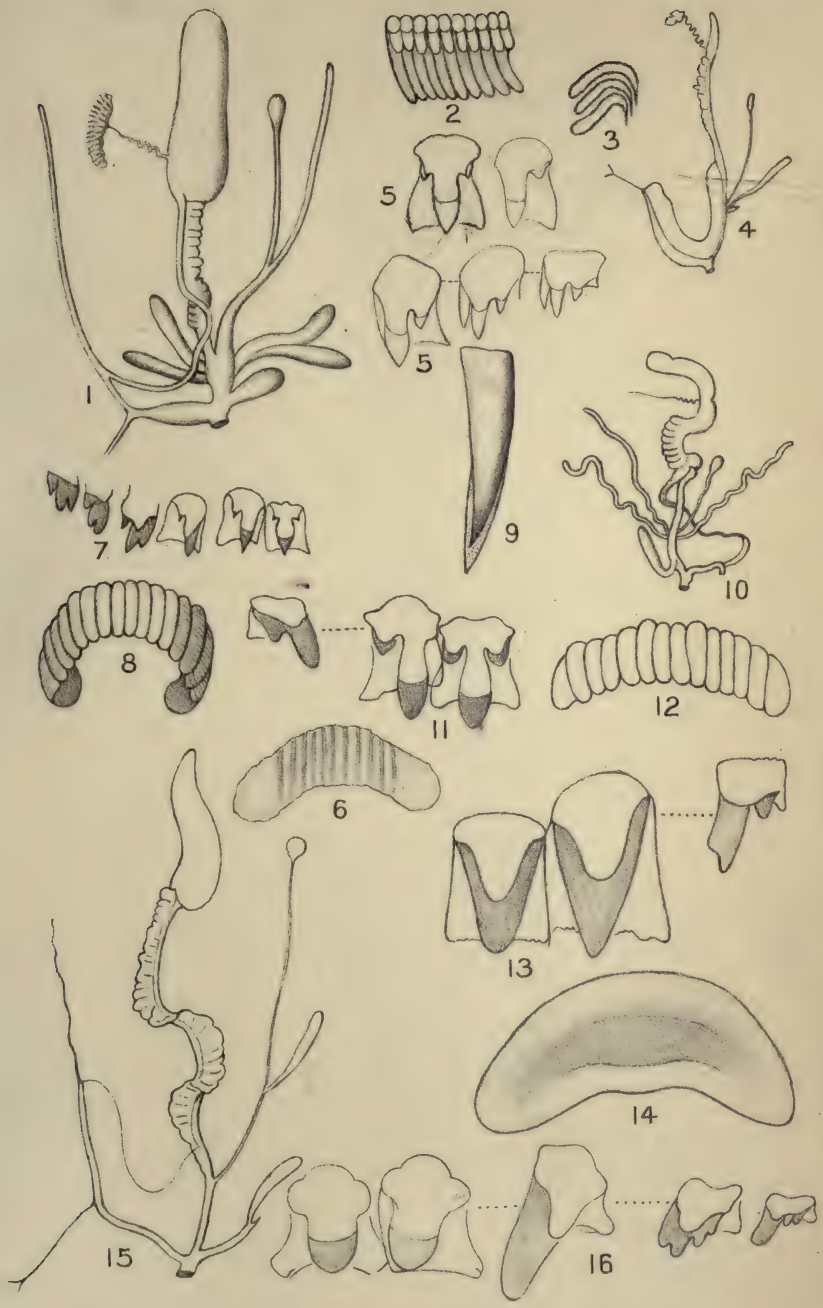
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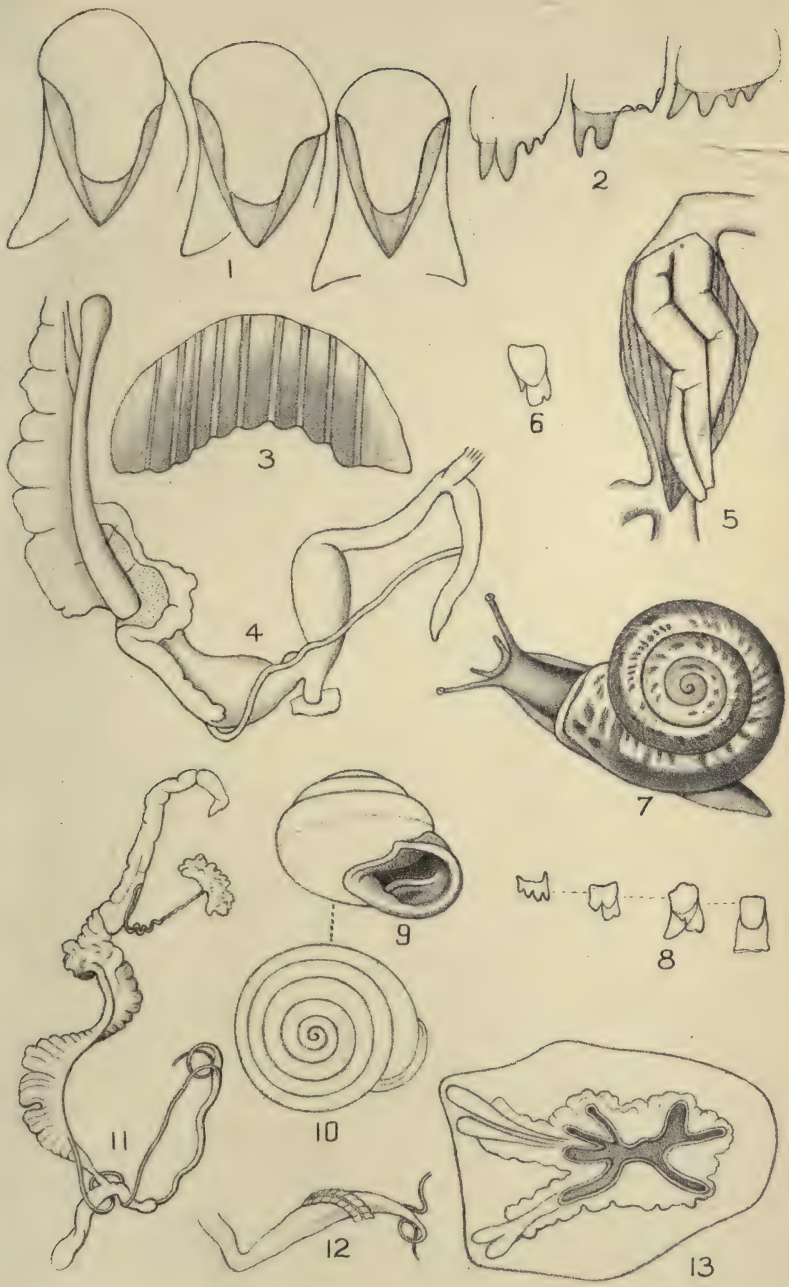
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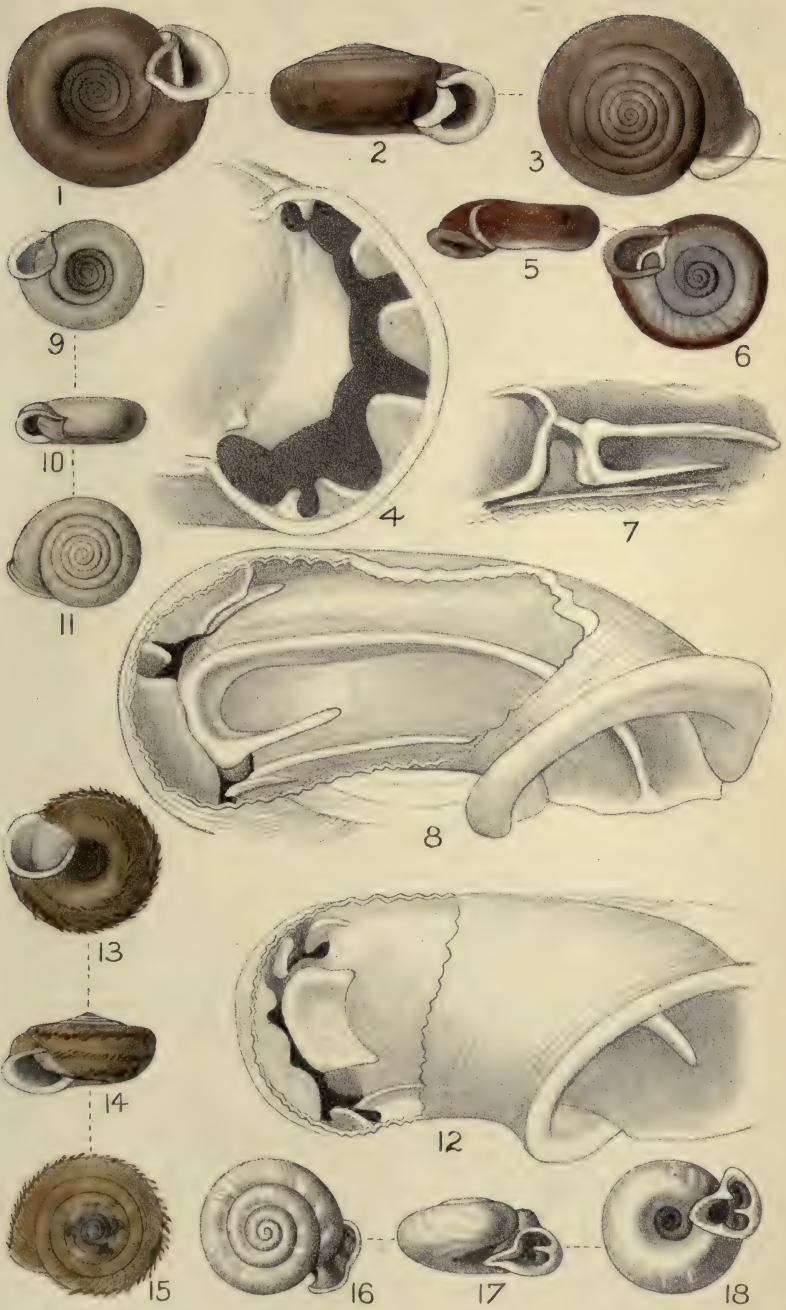
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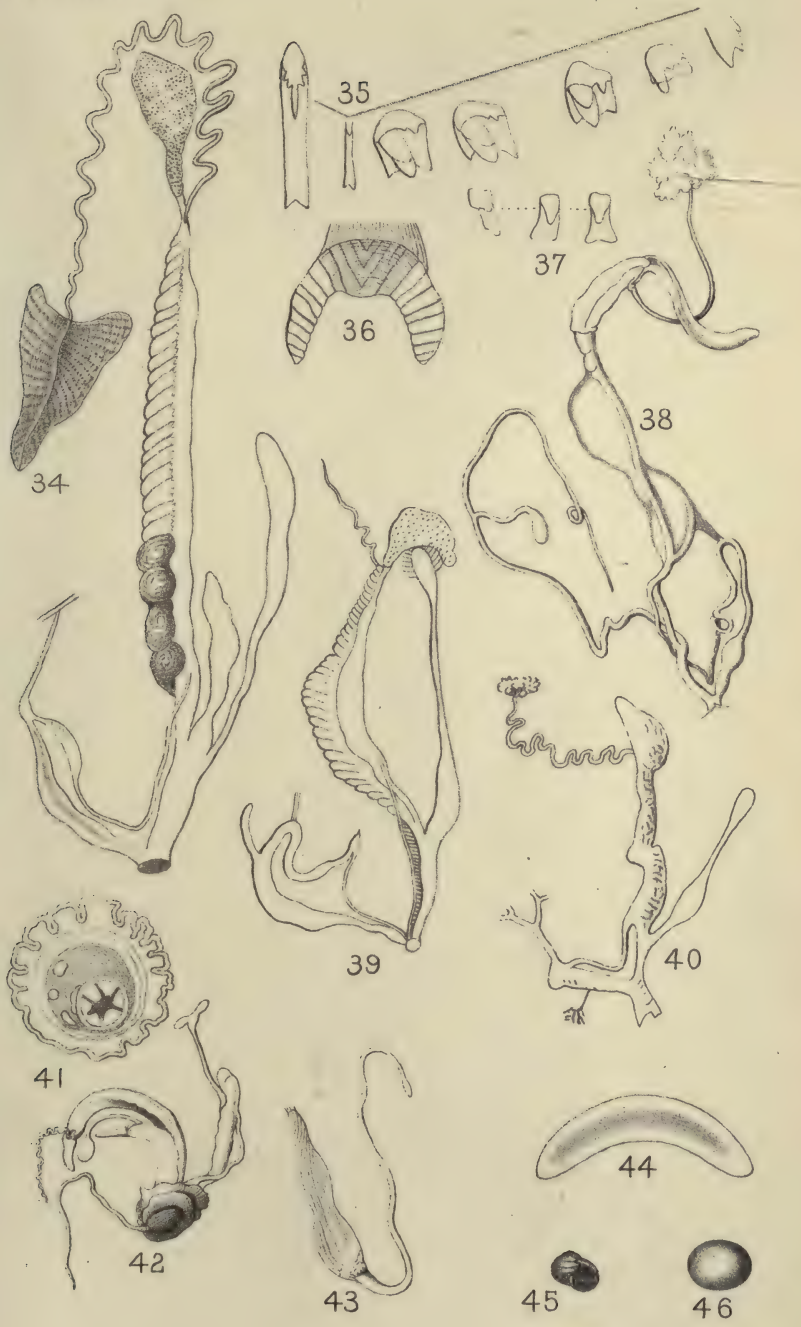
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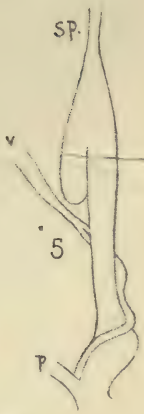
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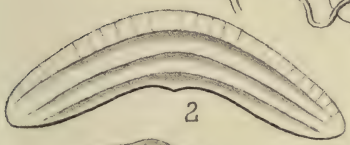
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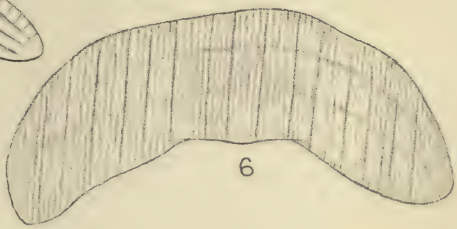
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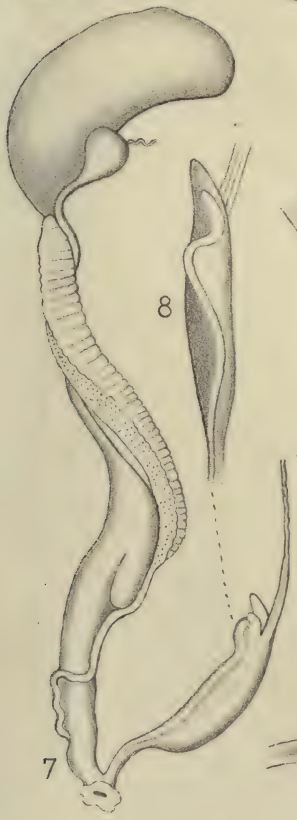
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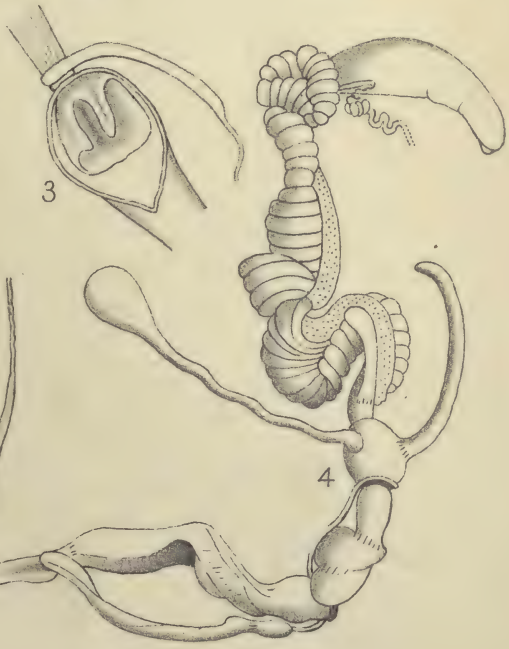
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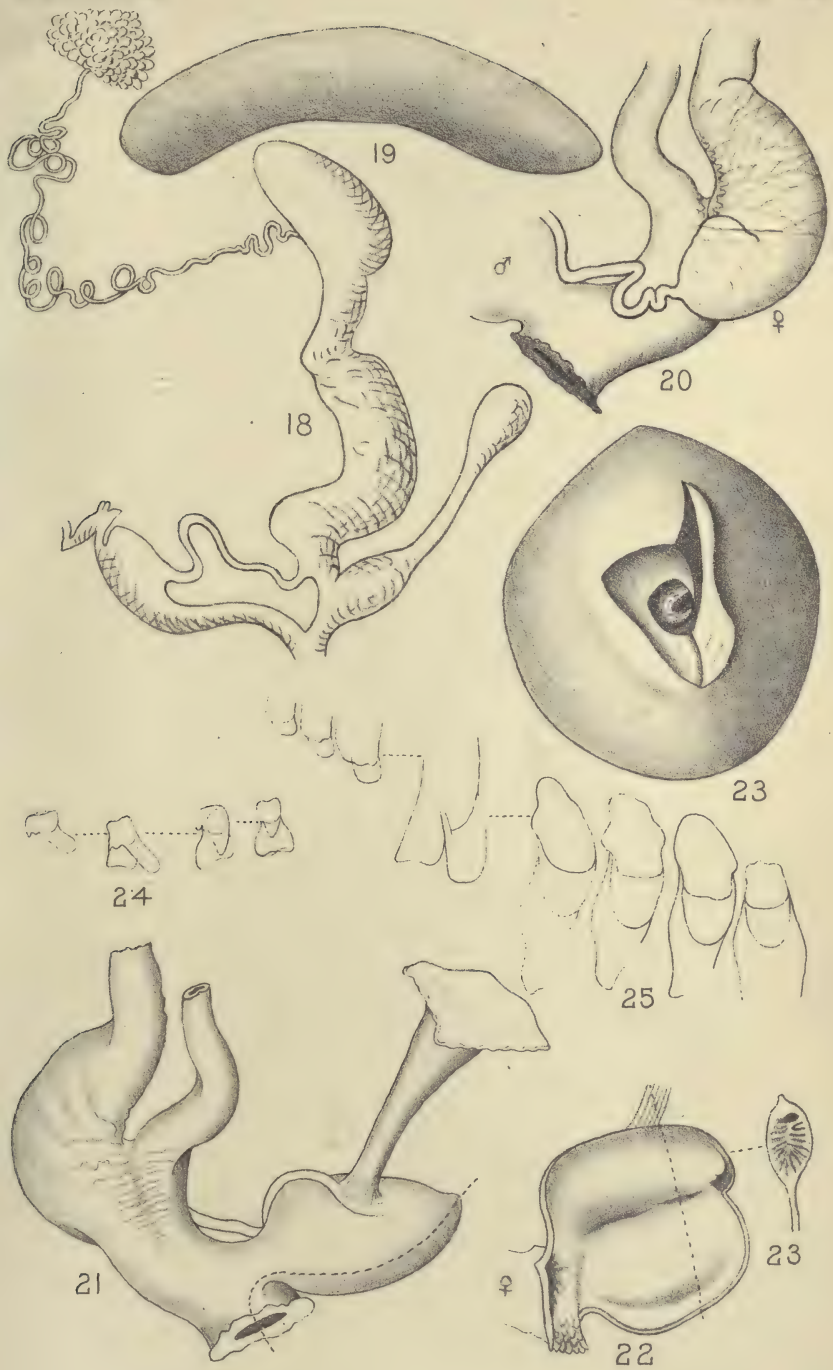
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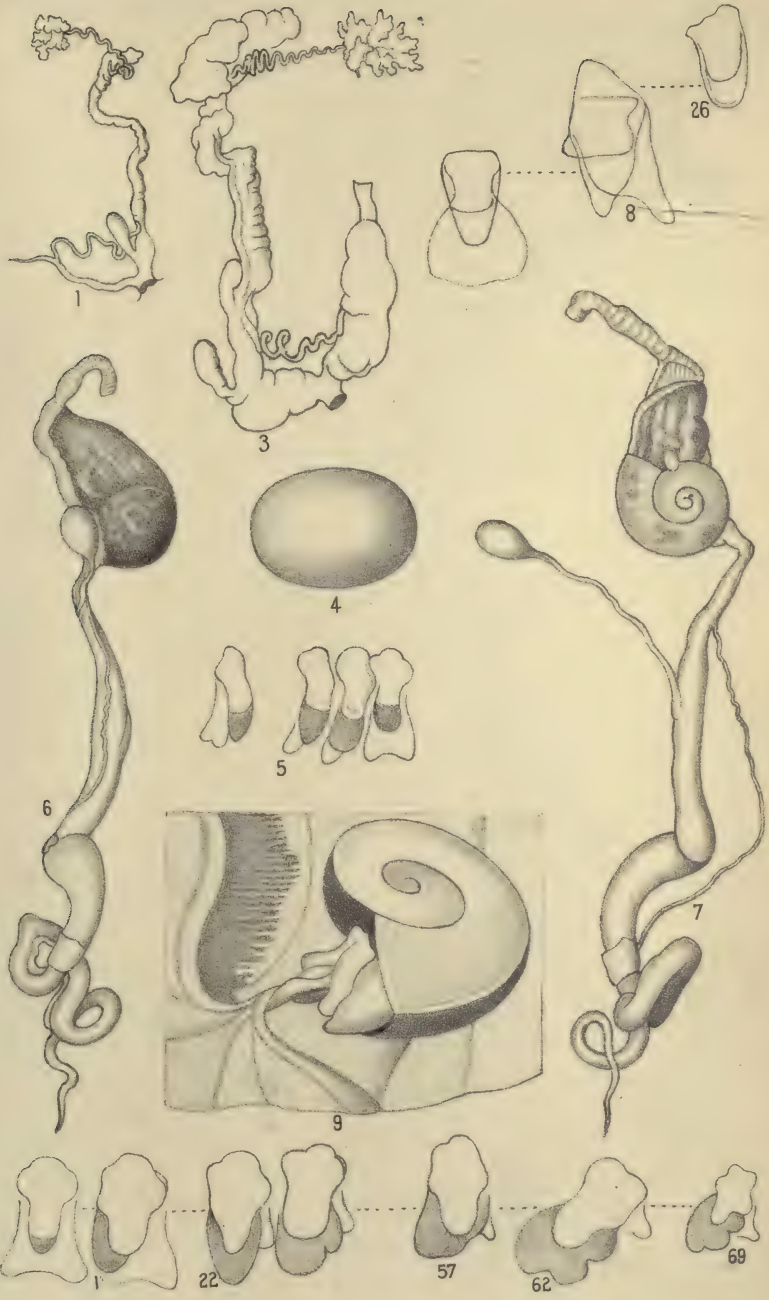
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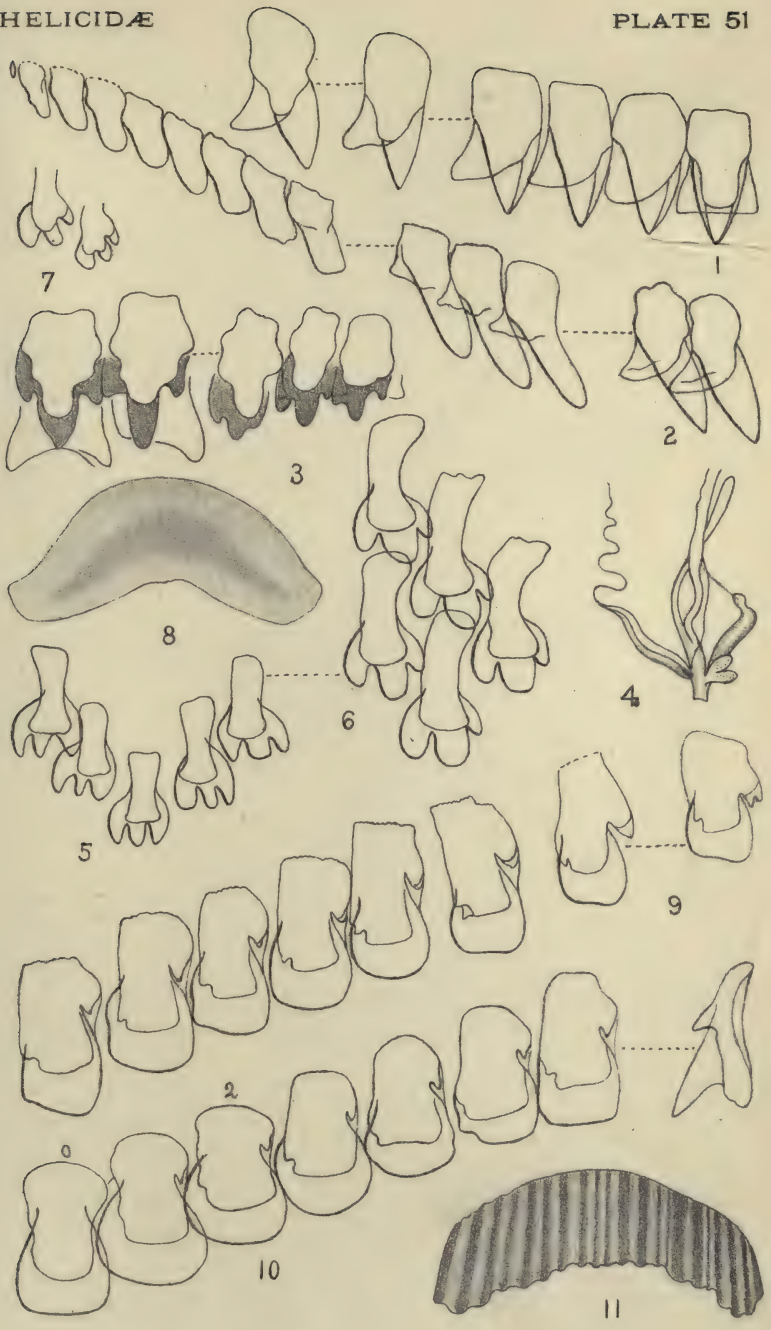
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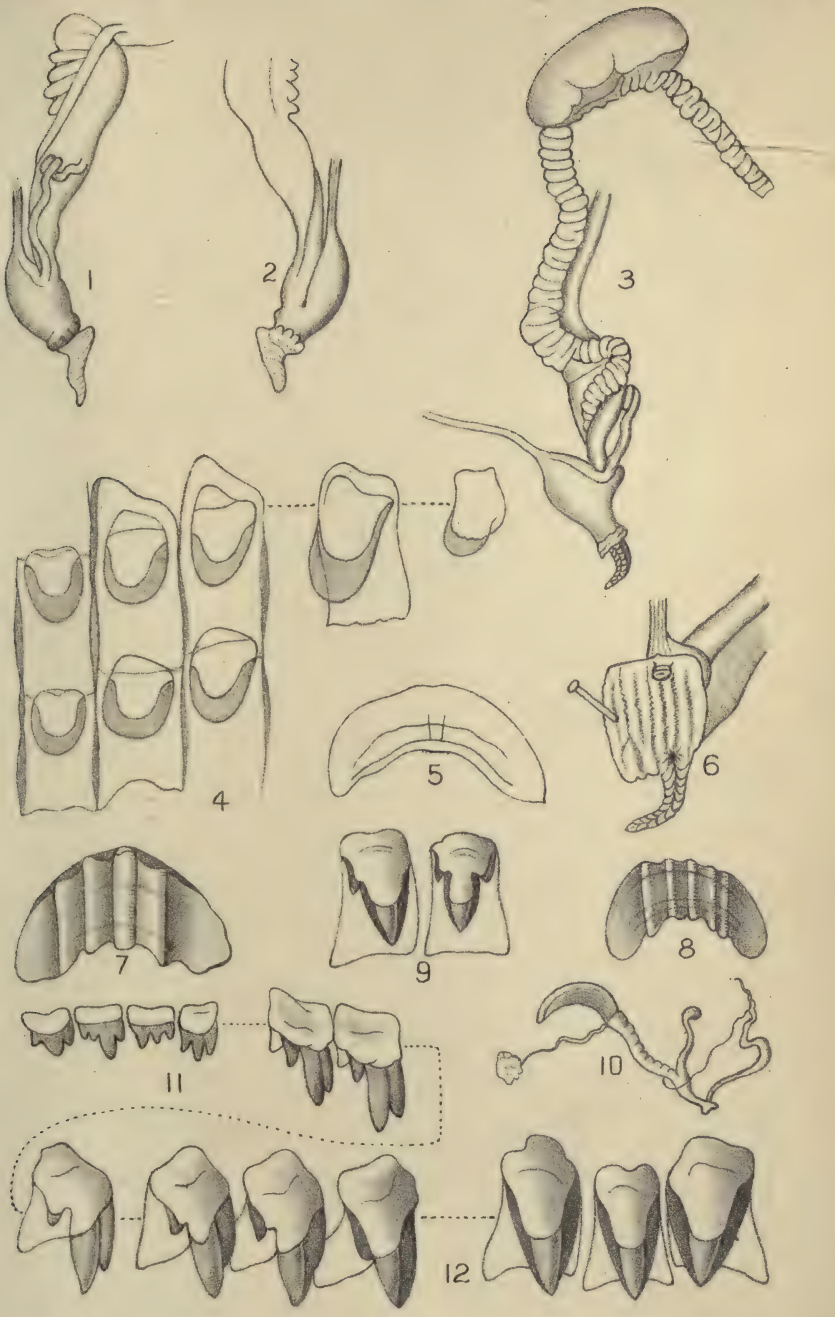
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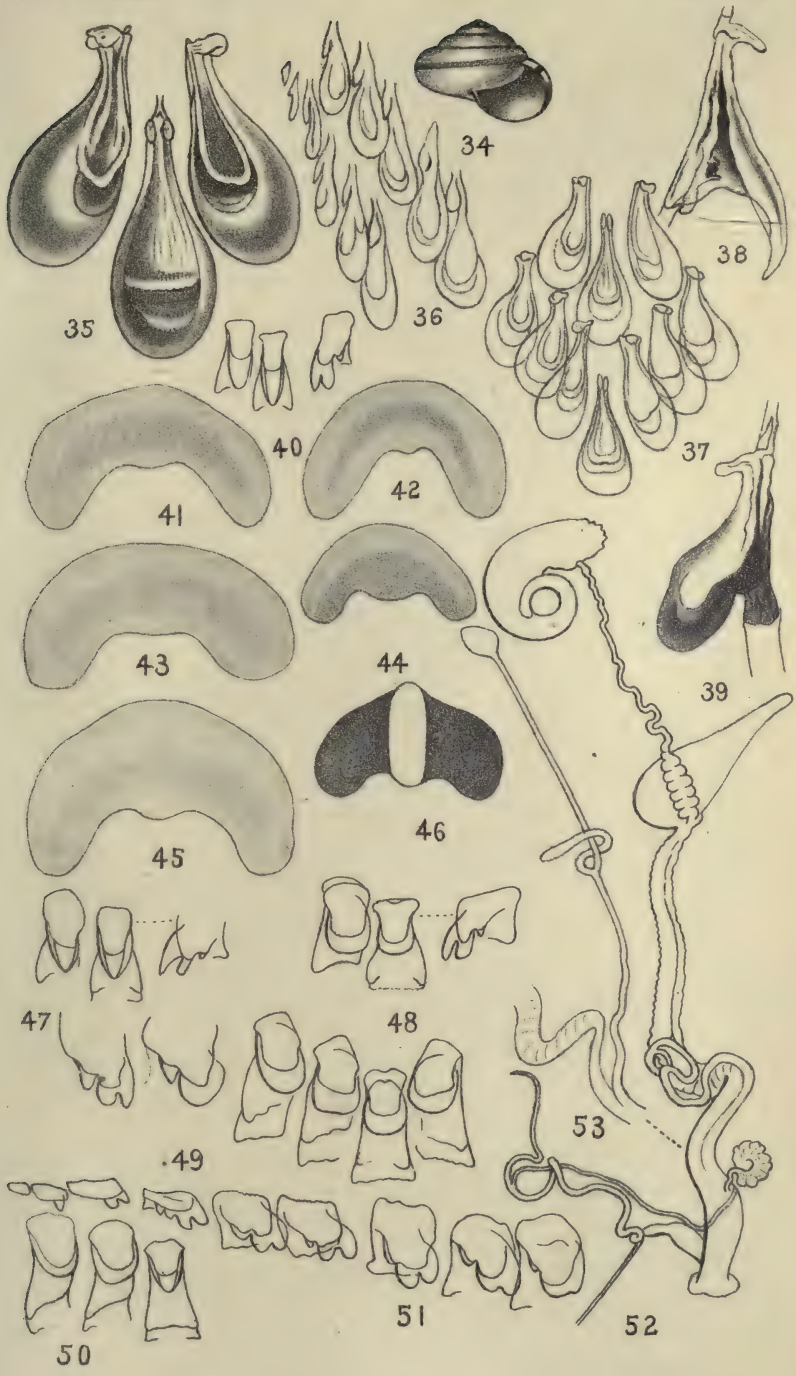
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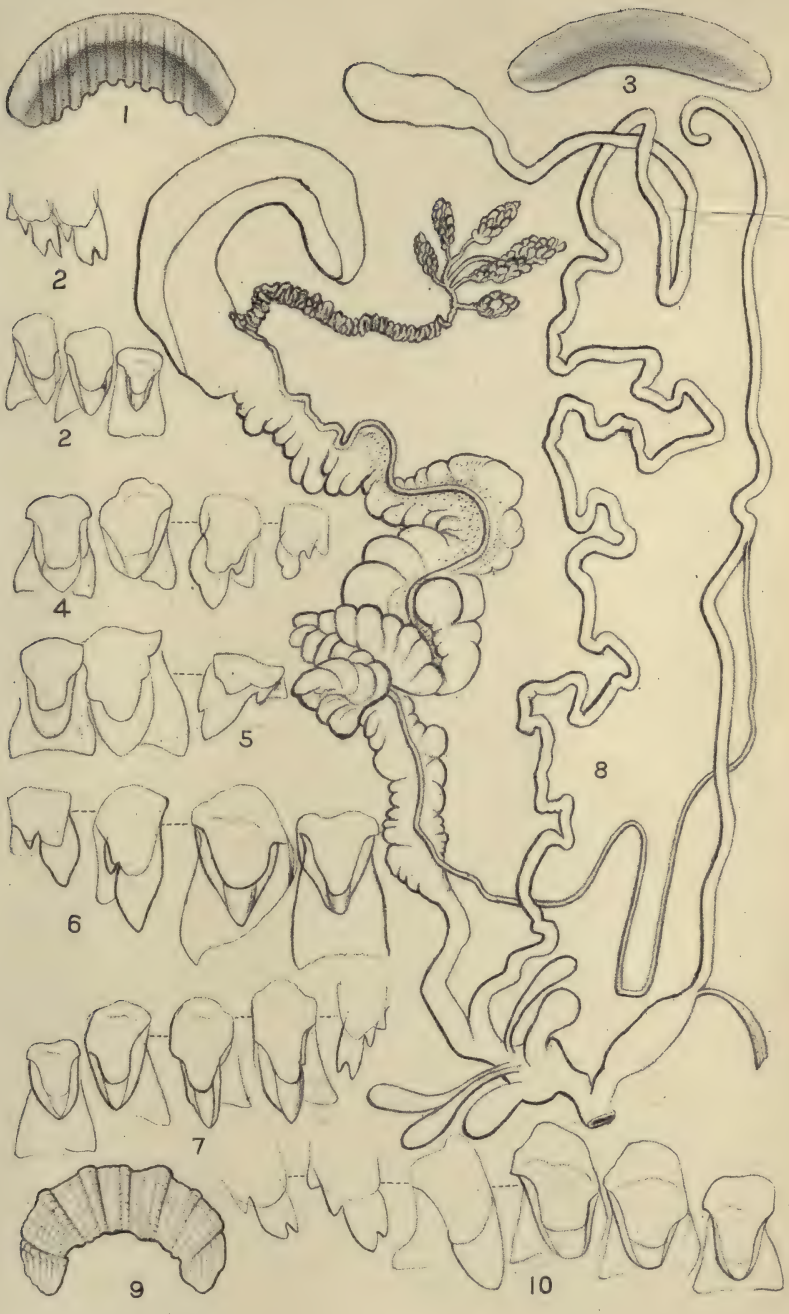
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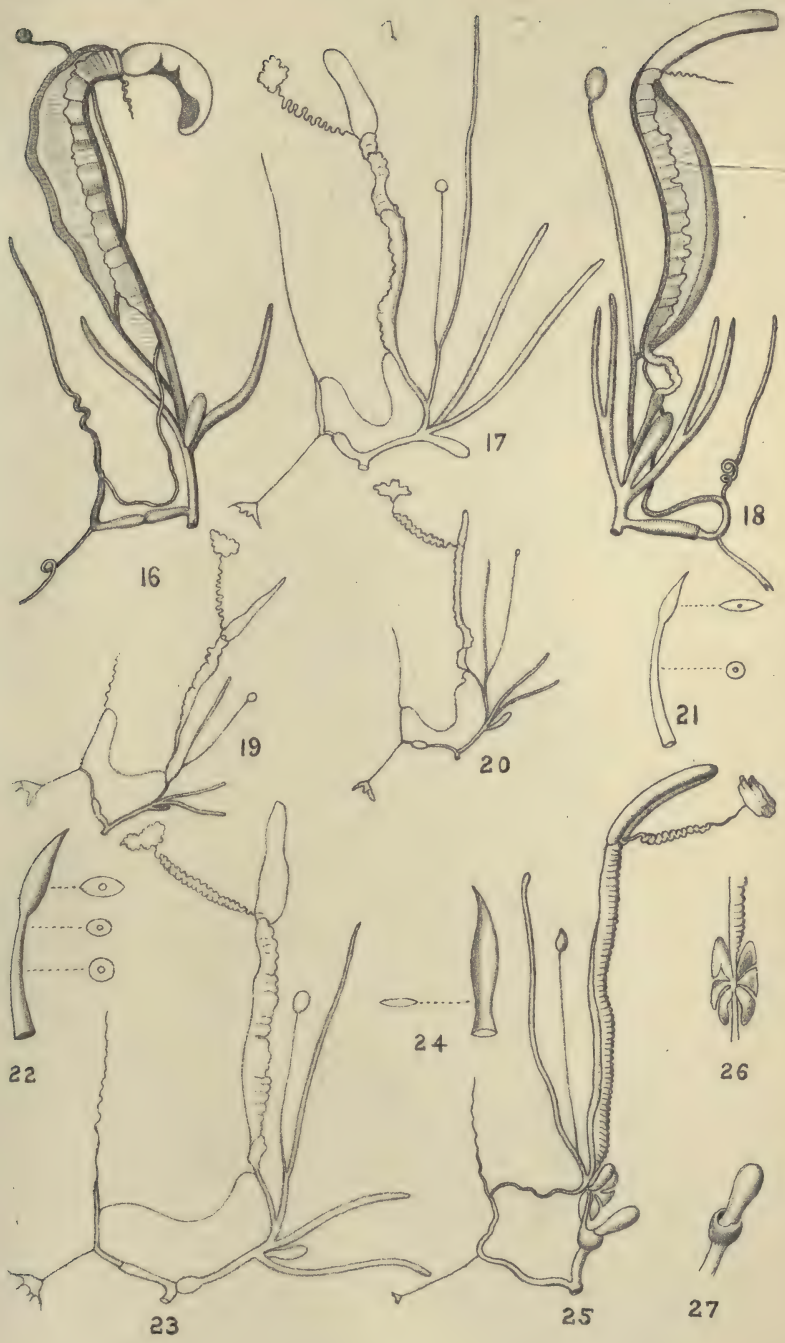
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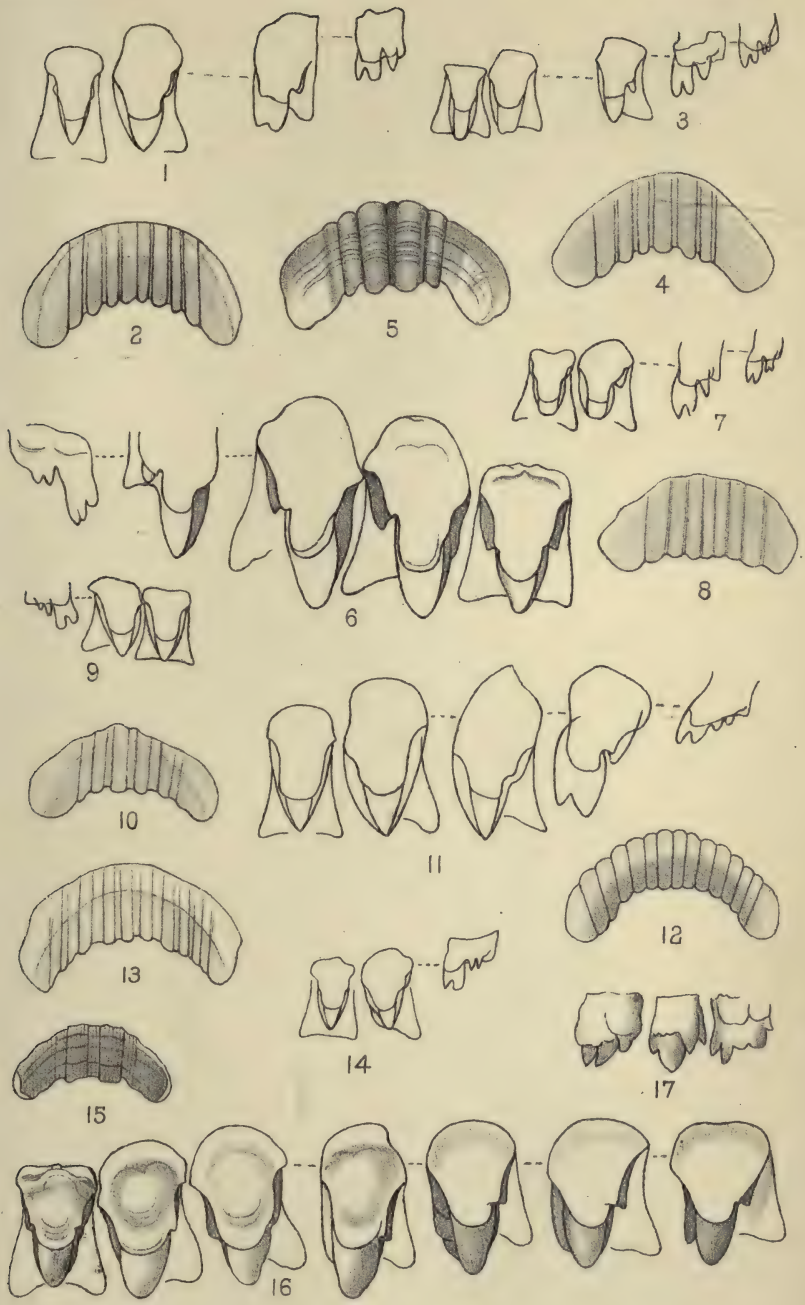
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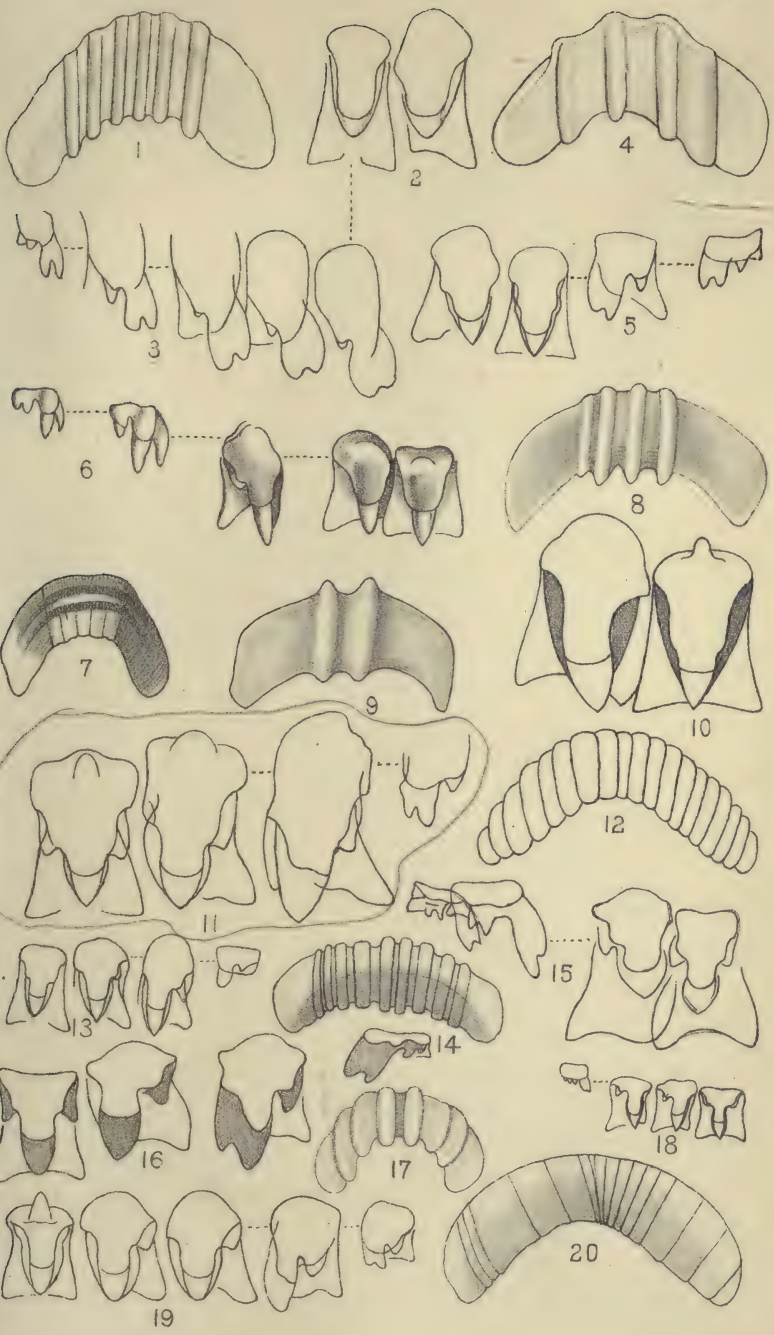
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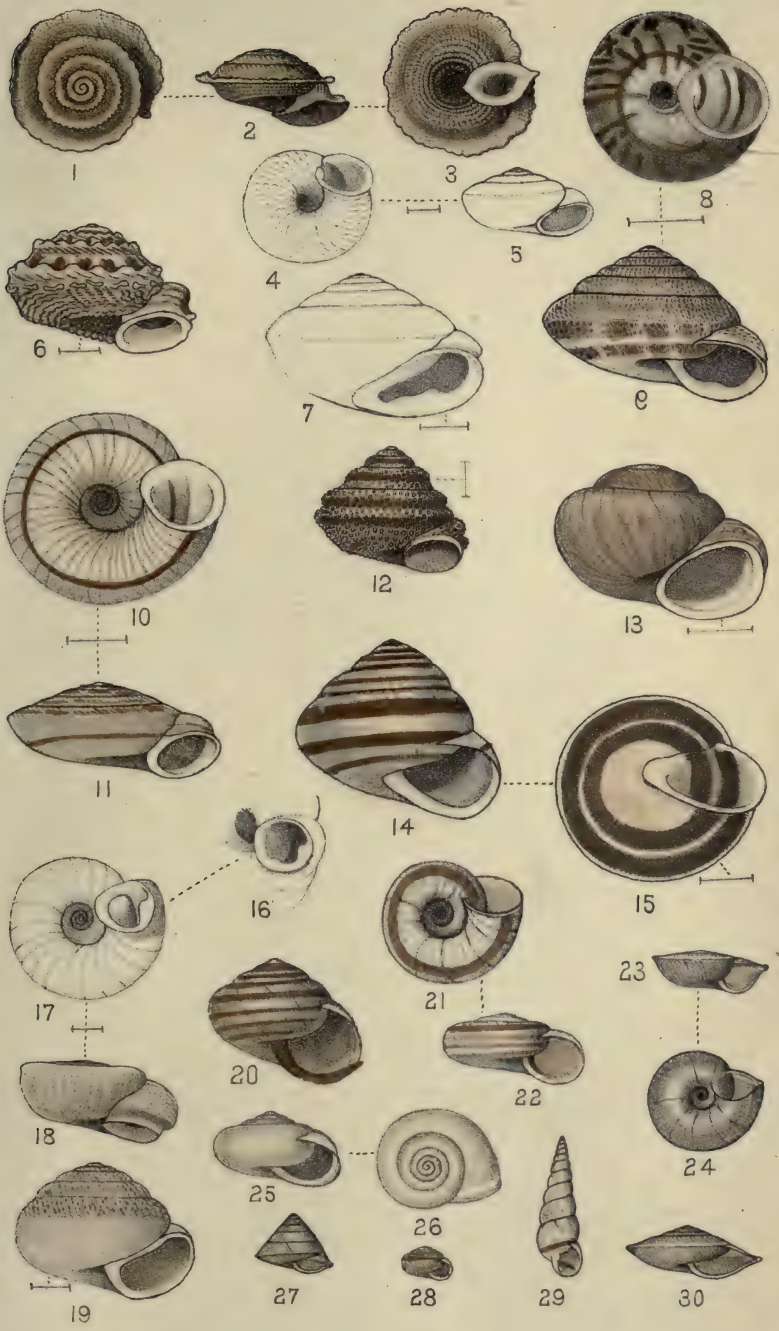
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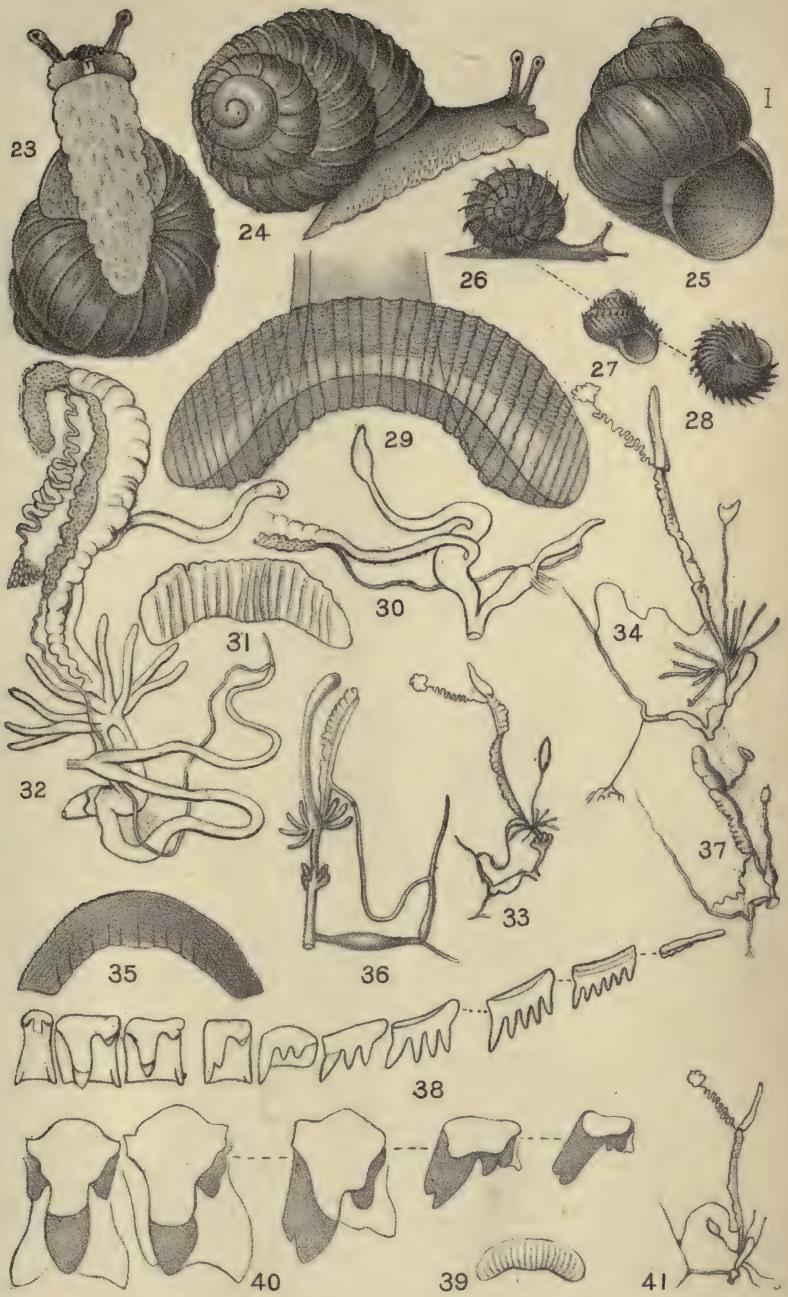
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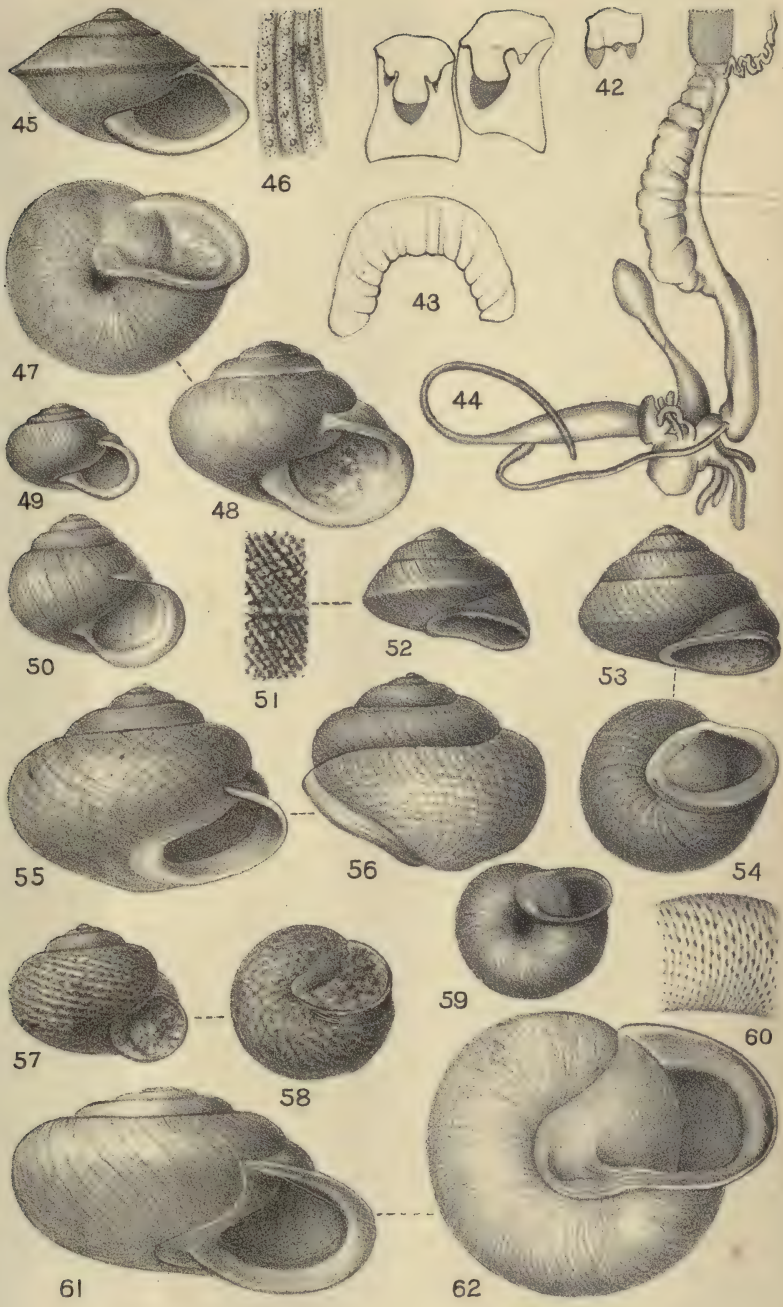
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